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NEW CHAPTERS IN THE WARFARE OF SCIENCE.

XI. FROM BABEL TO COMPARATIVE PHILOLOGY.

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PART II.

IN the first part of this article we saw the steps by which the sacred theory of human language had been developed; how it had been strengthened in every land until it seemed to bid defiance forever to secular thought; how it rested firmly upon the letter of Scripture, upon the explicit declarations of leading fathers of the Church, of the great doctors of the middle ages, of the most eminent theological scholars down to the beginning of the eighteenth century, and was guarded by the decrees of popes, bishops, Catholic and Protestant, kings, and the whole hierarchy of authorities in church and state.

And yet, as we now look back, it is easy to see that, even in that hour of its triumph, it was doomed.

The reason why the Church has so fully accepted the conclusions of science which have destroyed the sacred theory is instructive. The study of languages has been, since the revival of learning and the Reformation, a favorite study with the whole Western Church, Catholic and Protestant. The importance of understanding the ancient tongues in which our sacred books are preserved first stimulated the study, and church missionary efforts have contributed nobly to supply the material for extending it, and for the application of that comparative method which, in philology as in other sciences, has been so fruitful of good. Hence it is that so many leading theologians have come to know at first hand the truths given by this science, and to recognize its fundamental principles. What the conclusions which they, as well as

all other scholars in this field, have been absolutely forced to accept, I shall endeavor to show in this chapter.

The beginnings of a true and scientific theory seemed weak indeed, but they were none the less effective. As far back as 1661, Hottinger, professor at Heidelberg, came into the chorus of theologians like a great bell in a chime; but like a bell whose opening tone is harmonious, and whose closing tone is discordant. For while, at the beginning, Hottinger cites a formidable list of great scholars who had held the sacred theory of the origin of language, and here was in harmony with the chorus, he goes on to note a closer resemblance to the Hebrew in some languages than in others, and explains this by declaring that the confusion of tongues was of two sorts, total and partial: the Arabic and Chaldaic he thinks underwent only a partial confusion; the Egyptian, Persian, and all the European languages a total one: here comes in the discord; here gently sounds forth from the great chorus a new note—that idea of grouping and classifying languages which at a later day was to destroy utterly the whole sacred theory.

But the great chorus resounded on, as we have seen, from shore to shore, until the closing years of the seventeenth century; then arose men who silenced it forever. The first leader who threw the weight of his knowledge, thought, and authority against it was Leibnitz, the rival of Isaac Newton. He declared, "There is as much reason for supposing Hebrew to have been the primitive language of mankind as there is for adopting the view of Goropius, who published a work at Antwerp in 1580 to prove that Dutch was the language spoken in paradise." In a letter to Tenzel, Leibnitz wrote, "To call Hebrew the primitive language is like calling the branches of a tree primitive branches, or like imagining that in some country hewn trunks could grow instead of trees." He also asked very cogently, "If the primeval language existed even up to the time of Moses, whence came the Egyptian language?"

But the efficiency of Leibnitz did not end with mere suggestions. He applied the inductive method to linguistic study, and made great efforts to have vocabularies collected and grammars drawn up wherever missionaries and travelers came in contact with new races. He thus succeeded in giving the initial impulse to at least three notable collections—that of Catharine the Great, of Russia; that of the Spanish Jesuit, Lorenzo Hervas; and, at a later period, the Mithridates of Adelung. The interest of the Empress Catharine in her collection of linguistic materials was very strong, and her influence is seen in the fact that Washington, to please her, requested governors and generals to send in materials from various parts of the United States and Territories. The work of Hervas extended over the period from 1735 to 1809;

a missionary in America, he enlarged his catalogue of languages to six volumes, which were published in Spanish in 1800. His work contained specimens of more than three hundred languages, and the grammars of more than forty. It should be said to his credit that Hervas dared point out with especial care the limits of the Semitic family of languages, and declared, as a result of his enormous studies, that the various languages of mankind could not have been derived from the Hebrew.

While such work was done in Catholic Spain, Protestant Germany was honored by the work of Adelung. It contained the Lord's Prayer in nearly five hundred languages and dialects, and the comparison of these early in the nineteenth century helped to end the sway of Scriptural philology.

But the period which intervened between Leibnitz and this modern development was a period of philological chaos. It began mainly with the doubts which Leibnitz had forced upon Europe, and the end of it only began with the study of Sanskrit in the latter half of the eighteenth century, followed by the comparisons made by means of the collections of Catharine, Hervas, and Adelung at the beginning of the nineteenth. The old theory that Hebrew was the original language had fallen into disrepute, but nothing had taken its place as a finality. Great authorities, like Buddeus, were still cited in behalf of the narrower belief, but everywhere researches, unorganized though they were, tended to destroy it. The story of Babel continued indeed throughout the whole eighteenth century to hinder or warp scientific investigation, and a very curious illustration of this fact is seen in the book of Lord Nelme on The Origin and Elements of Language. He declares that the incident of the confusion was the cleaving of America from Europe, and regards the most terrible chapters in the Book of Job as intended for a description of the flood, which in all probability he had from Noah himself. Again, Rowland Jones tried to prove that Celtic was the primitive tongue, and that it passed through Babel unharmed. Still another effort was made by a Breton to prove that all languages took their rise in the language of Brittany. All was chaos. The old theory had gone to pieces, but no new theory had yet been formed. There was much wrangling, but little earnest controversy. Here and there theologians were calling out frantically, beseeching the Church to save the old doctrince as "essential to the truth of Scripture"; here and there other divines began to foreshadow the inevitable compromise which has always been thus vainly attempted in the history of every science. But it was soon seen by thinking men that no concessions as yet spoken of by theologians were sufficient. In the latter half of the century came the bloom period of the French philosophers and encyclopedists, of the Eng-

lish deists, of such German thinkers as Herder, Kant, and Lessing; and while here and there some writer on the theological side, like Perrin, amused thinking men by his flounderings in this great chaos, all remained without form and void.*

Nothing reveals to us better the darkness and duration of this chaos in England than a comparison of the articles on Philology given in the successive editions of the Encyclopædia Britannica. The first edition of that great mirror of British thought was printed in 1771; chaos reigns through the whole of its article on this subject. The writer divides languages into two classes, seems to indicate a mixture of divine inspiration with human invention, and finally escapes under a cloud. In the second edition, published in 1780, some progress has been made. The author states the sacred theory, and declares: "There are some divines who pretend that Hebrew was the language in which God talked with Adam in paradise, and that the saints will make use of it in heaven in those praises which they will eternally offer to the Almighty. These doctors seem to be as certain in regard to what is past as to what is to come."

This was evidently considered dangerous. It clearly outran the good sound belief of the average English Philistine; and accordingly we find in the third edition, published seventeen years later, a new article, in which, while the author gives, as he says, "the best arguments on both sides," he takes pains to adhere to a fairly orthodox theory.

This soothing dose is repeated in the fourth and fifth editions. In 1824 appeared a supplement to the fourth, fifth, and sixth editions, and this deals with the facts so far as they are known. There is scarcely a reference to the biblical theory throughout the article; and the author refers rather contemptuously to it. Three years later comes another supplement. While this Chaos was fast becoming Cosmos in Germany, such a change had evidently not gone far in England, for from this edition of the Encyclopædia the subject of philology is omitted. In fact, Babel and Philology made nearly as much trouble to encyclopedists as

* For Hottinger, see the preface to his Etymologicum Orientale, Frankfort, 1661. For Leibnitz, Catharine the Great, Hervas, and Adelung, see Max Müller, as above, from whom I have quoted very fully. See also Benfey, Geschichte der Sprachwissenschaft, etc., p. 269. Benfey declares that the Catalogue of Hervas is even now a mine for the philologist. For the first two citations from Leibnitz, as well as for a statement of his importance in the history of languages, see Max Müller as above, pp. 135, 136. For the third quotation, Leibnitz, Opera, Geneva, 1768, vi, Part. II, 232. For Nelme, see his Origin and Elements of Language, London, 1772, pp. 85–100. For Rowland Jones, see The Origin of Language and Nations, London, 1764, and preface. For the Origin of Languages in Brittany, see Le Brigant, Paris, 1787. For Herder and Lessing, see Canon Farrar's Treatise; on Lessing, see Sayce, as above. As to Perrin, see his essay Sur l'Origine et l'Antiquité des Langues, London, 1767.

Noah's Deluge and Geology. Just as in the latter case they had been obliged to stave off a presentation of scientific truth, by the words "For Deluge, see Flood," and "For Flood, see Noah," so in the former they were obliged to take various provisional measures—some of them comical. In 1842 came the seventh edition. In this the first part of the old article on philology which appeared in the third, fourth, and fifth editions was printed, but the supernatural part was mainly cut out. Yet we find a curious evidence of the continued reign of chaos in a foot-note inserted by the publishers, disavowing any departure from orthodox views. In 1859 appeared the eighth edition. This abandoned the old article entirely, and in its place was given a history of philology free from admixture of scriptural doctrines; and, finally, in the year 1885 appeared the ninth edition, in which Professors Whitney of Yale and Sievers of Tübingen give admirably and in short compass what is known of philology, throwing the sacred theory overboard entirely.

Such was that chaos of thought into which the discovery of Sanskrit suddenly threw its great light. Well does one of the foremost modern philologists say that this "was the electric spark which caused the floating elements to crystallize into regular forms." Among the first to bring the knowledge of Sanskrit to Europe were the Jesuit missionaries, whose services to the material basis of the science of comparative philology had already been so great, and the importance of the new discovery was soon seen among all scholars, whether orthodox or scientific. In 1784 the Asiatic Society at Calcutta was founded, and with it began Sanskrit philology. Scholars strong and earnest, like Sir William Jones, Carey, Wilkins, Foster, Colebrooke, did noble work in the new field. Light had come into the chaos, and a great new orb of science was steadily evolved.

The little group of scholars who gave themselves up to these researches, though almost without exception reverent Christians, were recognized at once by theologians as mortal foes of the whole old sacred theory of language. Not only was the dogma of the origin of languages at the Tower of Babel swept out of sight by the new discovery, but the still more vital dogma of the divine origin of languages, never before endangered, was felt to be in peril, since the evidence became overwhelming that so large a number of them had been produced by a process of natural growth.

Heroic efforts were therefore made, in the supposed interest of Scripture, to discredit the new learning. Even such a man as Dugald Stewart declared that the discovery of Sanskrit was altogether fraudulent, and endeavored to prove that the Brahmans had made it up from the vocabulary and grammar of Greek and

Latin. Others exercised their ingenuity in picking the new discovery to pieces, and still others attributed it all to the machinations of Satan.

On the other hand, the more thoughtful men in the Church endeavored to save something from the wreck of the old system by a compromise. They attempted to prove that Hebrew is at least a cognate tongue with the original speech of mankind, if not the original speech itself; but here they were confronted by the authority whom they dreaded most, the great Christian scholar, Sir William Jones himself. His words were: "I can only declare my belief that the language of Noah is irretrievably lost. After diligent search I can not find a single word used in common by the Arabian, Indian, and Tartar families, before the intermixture of dialects occasioned by the Mohammedan conquests."

So, too, in Germany came full acknowledgment of the new truth, and from a man won over to the Roman Catholic Church, Frederick Schlegel. He accepted the discoveries in the old language and literature of India as final: he saw the significance of these discoveries as regards philology, and grouped the languages of India, Persia, Greece, Italy, and Germany under the name afterward so universally accepted—Indo-Germanic.

It now began to be felt more and more, even among the most devoted churchmen, that the old theological dogmas regarding the origin of language, as held "always, everywhere, and by all," were wrong, and that Lucretius and sturdy old St. Gregory of Nyssa were right.

But this was not the only wreck. During ages the great men in the Church had been calling upon the world to wonder over the amazing exploit of Adam in naming the animals which Jehovah had brought before him, and to accept the history of language in the light of this exploit. The early fathers, the mediæval doctors, the great divines of the Reformation period, Catholic and Protestant, had united in this universal chorus. Clement of Alexandria declared Adam's naming of the animals proof of a prophetic gift. St. John Chrysostom insisted that it was an evidence of consummate intelligence. Eusebius held that the phrase "that was the name thereof" implied that each name embodied the real character and description of the animal concerned.

This view was echoed by a multitude of divines in the seventeenth and eighteenth centuries. Typical among these was the great Dr. South, who, in his sermon on The State of Man before the Fall, declared that "Adam came into the world a philosopher, which sufficiently appears by his writing the nature of things upon their names."

In the chorus of modern English divines there appeared one of eminence who declared against this theory: sturdy old Dr. Shuck-

ford, chaplain in ordinary to his Majesty George II, in the preface to his work on The Creation and Fall of Man, pronounced the whole theory "romantic and irrational." He goes on to say: "The original of our speaking was from God; not that God put into Adam's mouth the very sounds which he designed he should use as the names of things; but God made Adam with the powers of a man; he had the use of an understanding to form notions in his mind of the things about him, and he had the power to utter sounds which should be to himself the names of things according as he might think fit to call them."

This echo of Gregory of Nyssa was for many years of little avail. Historians of philosophy still began with Adam, because only a philosopher could have named all created things. There was, indeed, one difficulty which had much troubled some theologians; this was, that fishes were not specially mentioned among the animals brought by Jehovah before Adam for naming. To meet this difficulty there was much argument, and some theologians laid stress on the difficulty of bringing fishes from the sea to the garden of Eden to receive their names; but naturally other theologians replied to this that the almighty power which created the fishes could have easily brought them into the garden, one by one, even from the uttermost parts of the sea. This point, therefore, seems to have been left in abeyance.*

It had continued, then, the universal belief in the Church that the names of all created things, except possibly fishes, were given by Adam and in Hebrew; but all this theory was whelmed in ruin when it was found that there were other and, indeed, earlier names for the same animals than those in the Hebrew language; and especially was this enforced on sincere and thinking men when the Egyptian discoveries began to reveal the pictures of animals with their names in hieroglyphics at a period earlier than that agreed on by all the sacred chronologists as the date of the creation.

Still another part of the sacred theory now received its death-blow. Closely allied with the question of the origin of language was the origin of letters. The earlier writers had held that let-

* For the danger of "the little system of the history of the world," see Sayce, as above. On Dugald Stewart's contention, see Max Müller, Lectures on Language, pp. 167, 168. For Sir William Jones, see his Works, London, 1807, Part III, p. 199. For Schlegel, see Max Müller, as above. For an enormous list of great theologians from the fathers down, who dwelt on the divine inspiration and wonderful gifts of Adam on this subject, see Canon Farrar, Language and Languages. The citation from Clement of Alexandria is Strom. i, p. 335. See also Chrysostom, Hom. XIV in Genesin. Also, Eusebius, Præp. Evang. XI, p. 6. For the two quotations above given from Shuckford, see The Creation and Fall of Man, London, 1763, preface, p. lxxxiii; also his Sacred and Profane History of the World, 1753; revised edition by Wheeler, London, 1858. For the argument regarding the difficulty of bringing the fishes to be named into the garden of Eden, see Massey, Origin and Progress of Letters, London, 1763, pp. 14–19.

ters were also a divine gift given to Adam; but as we go on in the eighteenth century we find theological opinion inclining to the belief that this gift was reserved for Moses. This, as we have seen, was the view of St. John Chrysostom; and an eminent English divine early in the eighteenth century, John Johnson, Vicar of Kent, echoed it in the declaration concerning the alphabet, that "Moses first learned it from God by means of the lettering on the tables of the law." But here a difficulty arose: the biblical statement that God commanded Moses to "write in a book as decreed concerning Amalek" before he went up into Sinai. With this the good vicar grapples manfully. He supposes that God had previously concealed the tables of stone in Mount Horeb, and that Moses, "when he kept Jethro's sheep thereabout, had free access to these tables, and perused them at discretion, though he was not permitted to carry them down with him." Our author then asks for what other reason could God have kept Moses up in the mountain forty days at a time, except to teach him to write; and says, "It seems highly probable that the angel gave him the alphabet of the Hebrew, or in some other way unknown to us became his guide."

But this theory of letters was soon to be doomed like the other parts of the sacred theory. Studies in Comparative Philology based upon researches in India, began to be re-enforced by facts regarding the inscriptions in Egypt, the cuneiform inscriptions of Assyria, the legends of Chaldea, and the folk-lore of China, where it was found in their sacred books that the animals were named by Fohi, and with such wisdom and insight that every name disclosed the nature of the corresponding animal.

But, although the old theory was doomed, heroic efforts were still made to support it. In 1788 James Beattie, in all the glory of his Oxford doctorate and royal pension, made a tremendous onslaught, declaring the new system of philology to be "degrading to our nature." He says that the theory of the natural development of language is simply due to the beauty of Lucretius' poetry. But his main weapon is ridicule, and in this he shows himself a master. He tells the world, "The following paraphrase has nothing of the elegance of Horace or Lucretius, but seems to have all the elegance that so ridiculous a doctrine deserves":

> "When men out of the earth of old
> A dumb and beastly vermin crawled;
> For acorns, first, and holes of shelter,
> They tooth and nail, and helter skelter,
> Fought fist to fist; then with a club
> Each learned his brother brute to drub;
> Till, more experienced grown, these cattle
> Forged fit accoutrements for battle.

> At last (Lucretius says and Creech)
> They set their wits to work on *speech:*
> And that their thoughts might all have marks
> To make them known, these learned clerks
> Left off the trade of cracking crowns,
> And manufactured verbs and nouns."

But a far more powerful theologian entered the field in England to save the sacred theory of language—Dr. Adam Clarke. He was no less severe against Philology than against Geology. In 1804, as President of the Manchester Philological Society, he delivered an address in which he declared that, while men of all sects were eligible to membership, "he who rejects the establishment of what we believe to be a divine revelation, he who would disturb the peace of the quiet, and by doubtful disputations unhinge the minds of the simple and unreflecting, and endeavor to turn the unwary out of the way of peace and rational subordination, can have no seat among the members of this institution." The first sentence in this declaration gives food for reflection, for it is the same confusion of two ideas which has been at the root of so much interference of theology with science for the last two thousand years. Adam Clarke speaks of those "who reject the establishment of what '*we believe*' to be a divine revelation." Thus comes in that customary begging of the question—the substitution as the real significance of Scripture of "*what we believe*" for what *is*.

The intended result, too, of this ecclesiastical sentence was simple enough. It was, that great men, like Sir William Jones, Colebrooke, and their compeers, must not be heard in the Manchester Philological Society in discussion with Dr. Adam Clarke on questions regarding Sanskrit and other matters upon which they knew all that was then known, and Dr. Clarke knew nothing.

But even Clarke was forced to yield to the scientific current. Thirty years later, in his Commentary on the Old Testament, he pitched the claims of the sacred theory on a much lower key. He says: "Mankind was of one language, in all likelihood the Hebrew. . . . The proper names and other significations given in the Scripture seem incontestable evidence that the Hebrew language was the original language of the earth, the language in which God spoke to man, and in which he gave the revelation of his will to Moses and the prophets." Here are signs that this great champion is growing weaker in the faith; in the citations made it will be observed he no longer says "is," but "seems"; and finally we have him saying, "What the first language was is almost useless to inquire, as it is impossible to arrive at any satisfactory information on this point."

In France, during the first half of the nineteenth century, yet

more heavy artillery was wheeled into place, in order to make a last desperate defense of the sacred theory. The leaders in this effort were the three great Ultramontanes, De Maistre, De Bonald, and Lammenais. Condillac's contention that "languages were gradually and insensibly acquired, and that every man had his share of the general result," they attacked with reasoning based upon premises laid down in the Book of Genesis. De Maistre especially excels in ridiculing the philosophic or scientific theory. Lammenais, who afterward became so vexatious a thorn in the side of the Church, insisted, at this earlier period, that "man can no more think without words than see without light." And then, by that sort of mystical play upon words so well known in the higher ranges of theologic reasoning, he clinches his argument by saying, "The Word is truly and in every sense 'the light which lighteth every man that cometh into the world.'"

But even such leaders as these could not stay the progress of thought. While they seemed to be carrying everything before them in France, researches in philology made at such centers of thought as the Sorbonne and the College of France were undert mining the last great fortress. Curious indeed is it to find thathe Sorbonne, the stronghold of theology through so many centuries, was now made in the nineteenth century the arsenal and stronghold of the new ideas. But the most striking result of the new tendency in France was seen when the greatest of the three champions, Lammenais himself, though offered the highest church preferment, and even a cardinal's hat, braved the papal anathema, and went over to the scientific side.*

In Germany philological science took so strong a hold that its positions were soon recognized as impregnable. Leaders like the Schlegels, William von Humboldt, and, above all, Franz Bopp and Jacob Grimm, gave such additional force to scientific truth that it could no longer be withstood. To say nothing of other conquests, the demonstration of that great law in philology which bears Grimm's name brought home to all thinking men the evi-

* For Johnson's work, showing how Moses learned the alphabet, see the Collection of Discourses by Rev. John Johnson, A. M., Vicar of Kent, London, 1728, p. 42, and the preface. For Beattie, see his Theory of Language, London, 1788, p. 98; also pp. 100, 101. For Adam Clarke, see, for the speech cited, his Miscellaneous Works, London, 1837; for the passage from his Commentary, see the London edition of 1836, vol. i, p. 93; for the other passage, see Introduction to Bibliographical Miscellany, quoted in article, Origin of Language and Alphabetical Characters, in Methodist Magazine, vol. xv, p. 214. For De Bonald, see his Recherches Philosophiques, Part III, chap. ii, De l'Origine du Langage, in Œuvres Complètes, Paris, 1859, pp. 64–78, *passim*. For Joseph De Maistre, see his Œuvres, Bruxelles, 1852, vol. i, Les Soirées de Saint Petersbourg, deuxième entretien, *passim*. For Lammenais, see his Œuvres Complètes, Paris, 1836–'37, tome ii, 78–81, chap. xv of Essai sur l'Indifférence en Matière de Religion.

dence that the evolution of language has not been determined by the philosophic utterances of Adam in naming the animals which Jehovah brought before him, but in obedience to natural law.

True, a few devoted theologians showed themselves willing to lead a forlorn hope; and perhaps the most forlorn of all was that of 1840, led by Dr. Gottlieb Christian Kayser, Professor of Theology at the Protestant University of Erlangen. He did not, indeed, dare put in the old claim that Hebrew is identical with the primitive tongue, but he insists that it is nearer it than any other. He relinquishes the two former theological strongholds—first, the idea that language was taught by the Almighty to Adam, and, next, that the alphabet was thus taught to Moses—and falls back on the position that all tongues are thus derived from Noah, giving as an example the language of the Caribbees, and insisting that it was evidently so derived. What chance similarity in words between Hebrew and the Caribbee tongue he had in mind is past finding out. He comes out strongly in defense of the biblical account of the Tower of Babel, and insists that by the "symbolical expression 'God said, Let us go down,' a further natural phenomenon is intimated, to wit, the cleaving of the earth, whereby the return of the dispersed became impossible—that is to say, through a new or not universal flood, a partial inundation and temporary violent separation of great continents until the time of the rediscovery." By these words the learned doctor means nothing less than the separation of Europe from America.

But while at the middle of the nineteenth century the theory of the origin and development of language was upon the continent considered as settled, and a well-ordered science had there emerged from the old chaos, Great Britain still held back, in spite of the fact that the most important contributors to the science were of British origin. Leaders in every English church and sect vied with each other, either in denouncing the encroachments of the science of language or in explaining it away.

But a new epoch had come, and in a way least expected. Perhaps the most notable effort in bringing it in was made by Dr. Wiseman, afterward Cardinal Archbishop of Westminster. His is one of the best examples of a method which has been used with considerable effect during the latest stages in nearly all the controversies between theology and science. It consists in stating, with much apparent fairness, the conclusions of the scientific authorities, and then in making the astounding assertion that the Church has always accepted them and accepts them now as "additional proofs of the truth of Scripture" A little juggling with words, a little amalgamation of texts, a little judicious suppression, a little imaginative deduction, a little unctuous phrasing, and the thing is done. One great service this eminent Catholic

champion undoubtedly rendered: by this acknowledgment so widely spread in his published lectures, he made it impossible for Catholics or Protestants longer to resist the main conclusions of science. Henceforward we only have efforts to save theological appearances, and these only by men whose zeal outran their discretion.

On both sides of the Atlantic, down to a recent period, we see these efforts, but we see no less clearly that they are mutually destructive. Yet out of this chaos among English-speaking peoples the new science began to develop steadily and rapidly. Attempts did indeed continue here and there to save the old theory. Even as late as 1859 we hear the eminent Presbyterian divine, Dr. John Cumming, from his pulpit in London, speaking of Hebrew as "that magnificent tongue—that mother-tongue, from which all others are but distant and debilitated progenies."

But the honor of producing in the nineteenth century the most absurd known attempt to prove Hebrew the primitive tongue belongs to the youngest of the continents, Australia. In the year 1857 was printed at Melbourne The Triumph of Truth, or a Popular Lecture on the Origin of Languages, by B. Atkinson, M. R. C. P. L.—whatever that may mean. In this work, starting with the assertion that "the Hebrew was the primary stock whence all languages were derived," the author states that Sanskrit is "a dialect of the Hebrew," and declares that "the manuscripts found with mummies agree precisely with the Chinese version of the Psalms of David." It all sounds like Alice in Wonderland. Curiously enough, in the latter part of his book, evidently thinking that his views would not give him authority among fastidious philologists, he says, "A great deal of our consent to the foregoing statements arises in our belief in the divine inspiration of the Mosaic account of the creation of the world and of our first parents in the garden of Eden." A yet more interesting light is thrown upon the author's view of truth and its promulgation by his dedication; he says that, "being persuaded that literary men ought to be fostered by the hand of power," he dedicates his treatise "to his Excellency Sir H. Barkly," who was at the time Governor of Victoria.

Still another curious survival is seen in a work which appeared as late as 1885, at Edinburgh, by William Galloway, M. A., Ph. D., M. D. The author thinks that he has produced abundant evidence to prove that "Jehovah, the Second Person of the Godhead, wrote the first chapter of Genesis on a stone pillar; and that this is the manner by which he first revealed it to Adam; and thus Adam was taught not only to speak but to read and write by Jehovah, the Divine Son; and that the first lesson he got was from the first chapter of Genesis." He goes on to say:

"Jehovah wrote these first two documents; the first containing the history of the Creation, and the second the revelation of man's redemption, . . . for Adam's and Eve's instruction; and it is evident that he wrote them in the Hebrew tongue, because that was the language of Adam and Eve." But this was only a flower out of season.

And finally in these latter days Mr. Gladstone has touched the subject. With that well-known facility in believing anything he wishes to believe, which he once showed in his connection of Neptune's trident with the doctrine of the Trinity, he floats airily over all the impossibilities of the original Babel legend and all the conquests of science, makes an assertion regarding the results of philology which no philologist of any standing would admit, and then escapes in a cloud of rhetoric after his well-known fashion. This, too, must be set down simply as a survival; in the British Isles as elsewhere the truth has been established. Such men as Max Müller and Sayce in England; Steinthal, Schleicher, Weber, Karl Abel, and a host of others in Germany; Ascoli and De Gubernatis in Italy; and Whitney, with the scholars inspired by him, in America, have carried the new science to a complete triumph. The sons of Yale University may well be proud of the fact that this old Puritan foundation was made the headquarters of the American Oriental Society, which has done so much for the truth in this field.*

It may be instructive, in conclusion, to sum up briefly the history of the whole struggle.

First, as to the origin of speech, we have in the beginning the whole Church rallying around the idea that the original language was Hebrew; that this language, even including the mediæval rabbinical punctuation, was directly inspired by the Almighty; that Adam was taught it by God himself in walks and talks; and that all other languages were derived from it at the "confusion of Babel."

Next, we see parts of this theory fading out: the inspiration of the rabbinical points begins to disappear; Adam, instead of being taught directly by God, is "inspired" by him.

Then comes the third stage: advanced theologians endeavor to compromise on the idea that Adam was "given verbal roots and a mental power."

Finally, in our time, we have them accepting the theory that language is the result of an evolutionary process in obedience to

* For Mr. Gladstone's view, see his Impregnable Rock of Holy Scripture, London, 1890, p. 241 *et seq.* The passage connecting the trident of Neptune with the Trinity is in his Juventus Mundi. To any American boy who sees how inevitably, both among Indian and white fishermen, the fish-spear takes this three-pronged form, this utterance of Mr. Gladstone is amazing.

laws more or less clearly ascertained. Babel thus takes its place quietly among the sacred myths.

Secondly, as to the origin of writing, we have the more eminent theologians at first insisting that God taught Adam to write; next we find them gradually retreating from this position, but insisting that writing was taught to the world by Noah. After the retreat from this position, we find them insisting that it was Moses whom God taught to write. But scientific modes of thought still progressed, and we next have influential theologians agreeing that writing was a Mosaic invention; this is followed by another theological retreat to the position that writing was a post-Mosaic invention. Finally, all the positions are relinquished, save by some few skirmishers who appear now and then upon the horizon, making attempts to defend some subtle method of incorporating the Babel myth into modern science.

Just after the middle of the nineteenth century a new system of theological defense appears. It is that which is seen in the history of almost every science after it has successfully fought its way through the theological period—the declaration that the scientific discoveries in question are nothing new, but have really always been known and held by the Church, and that they simply substantiate the position taken by the Church. This new contention, which always betokens the last gasp of theological resistance to science, was now echoed from land to land. In 1856 it was given forth by a divine of the Anglican Church, Archdeacon Pratt, of Calcutta. He gives a long list of eminent philologists who had done most to destroy the old supernatural view of language, reads into their utterances his own wishes, and then exclaims, "So singularly do their labors confirm the literal truth of Scripture."

Two years later this contention is echoed from the American Presbyterian Church, and Dr. B. W. Dwight, having stigmatized as "infidels" those who have not incorporated into their science the literal acceptance of Hebrew legend, declares that "chronology, ethnography, and etymology have all been tortured in vain to make them contradict the Mosaic account of the early history of man." Twelve years later another echo comes from the Roman Catholic Church. The Rev. Dr. Baylee, Principal of the College of St. Aidan's in England, declares, "With regard to the varieties of human language, the account of the confusion of tongues is receiving daily confirmation by all the recent discoveries in comparative philology." And this is echoed in the same year (1870) from the United Presbyterian Church of Scotland, when Dr. John Eadie, Professor of Biblical Literature and Exegesis, declares that "comparative philology has established the miracle of Babel."

A skill in theology and casuistry so exquisitely developed as to permit such assertions, and a faith so robust as to warrant their acceptance, leave certainly nothing to be desired. But how baseless these contentions are is seen, first, by the simple history of the attitude of the Church toward this question; and, secondly, by the fact that comparative philology now reveals beyond a doubt that not only is Hebrew not the original or oldest language upon earth, but that it is not even the oldest form in the Semitic group to which it belongs. To use the language of one of the most eminent modern authorities, "It is now generally recognized that in grammatical structure the Arabic preserves much more of the original forms than either the Hebrew or Aramaic."

Science places inexorably the account of the confusion of tongues and the dispersion of races at Babel among the myths.

A more complete relinquishment of the old contention is made by Archdeacon Farrar, Canon of Westminster. With a boldness which in an earlier period might have cost him dear, but which merits praise even in this time for its courage, he says: "For all reasoners except that portion of the clergy who in all ages have been found among the bitterest enemies of scientific discovery, these considerations have been conclusive. But, strange to say, here, as in so many other instances, this self-styled orthodoxy—more orthodox than the Bible itself—directly contradicts the very Scriptures which it professes to explain, and by sheer misrepresentation succeeds in producing a needless and deplorable collision between the statements of Scripture and those other mighty and certain truths which have been revealed to science and humanity as their glory and reward."

Still another most honorable acknowledgment was made in America through the instrumentality of a divine of the Methodist Episcopal Church, whom the present generation at least will hold in honor, not only for his scholarship, but for his patriotism in the darkest hour of his country's need—John McClintock. In the article on Language, in the Biblical Cyclopædia, edited by him and the Rev. Dr. Strong, which appeared in 1873, the whole sacred theory is quietly given up, and the scientific view accepted.*

* For Kayser, see his work, Ueber die Ursprache, oder über eine Behauptung Mosis, dass alle Sprachen der Welt von einer einzigen der Noachischen abstammen, Erlangen, 1840, 192 pp.; see especially pp. 5, 80, 95, 112. For Wiseman, see his Lectures on the Connection between Science and Revealed Religion, London, 1836. For examples typical of very many in this field, see the Works of Pratt, 1856; Dwight, 1858; Jamieson, 1868. For citation from Cumming, see his Great Tribulation, London, 1859, p. 4; see also his Things hard to be understood, London, 1861, p. 48. For an admirable summary of the work of the great modern philologists, and a most careful estimate of the conclusions reached, see Prof. Whitney's article on Philology in the Encyclopædia Britannica. A copy of Mr. Atkinson's book is in the Harvard College Library, it having been presented by the

It may, indeed, be now fairly said that the thinking leaders of theology have come to accept the conclusions of science regarding the origin of language, as against the old explanations by myth and legend. The result has been a blessing both to science and to religion. No harm has been done to religion; what has been done is to release it from the clog of theories, which thinking men saw could no longer be maintained. No matter what has become of the naming of the animals by Adam, the origin of the name of Babel, the fears of the Almighty lest men might climb up into his realm above the firmament, the confusion of tongues and the dispersion of nations; the essentials of Christianity, as taught by its Blessed Founder, have simply been freed, by comparative philology, from one more great incubus and incumbrance, and have therefore been left to work with more power upon the hearts, minds, and conduct of mankind.

Nor has any harm been done to the Bible. On the contrary, it has been made, by this new divine revelation through science, all the more precious to us. In these myths and legends caught from earlier civilizations, we see an evolution of the most important religious and moral truths for our race. Myth, legend, and parable seem, in obedience to a divine law, the necessary setting for these truths, as they are successively evolved, ever in higher and higher forms. What matters it then that we have come to know that the accounts of Creation and many early events in the sacred books were remembrances of lore obtained from the Chaldeans? What matters it that the beautiful story of Joseph is found to be in part derived from an Egyptian romance, of which the hieroglyphs may still be seen? What matters it that the story of David and Goliath is poetry; and that Samson, like so many men of strength in other religions, is probably a sun-myth? What matters it that the inculcation of high duty in the childhood of the world is embodied in such quaint stories as those of Jonah and Balaam? The more we realize these facts the richer becomes that great body of literature

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Trustees of the Public Library of Victoria. For Galloway, see his Philosophy of the Creation, Edinburgh and London, 1885, pp. 21, 238, 239, 446. For citation from Baylee, see his Verbal Inspiration the True Characteristic of God's Holy Word, London, 1870, p. 14, and elsewhere. For Archdeacon Pratt, see his Scripture and Science not at Variance, London, 1856, p. 55. For the citation from Dr. Eadie, see his Biblical Cyclopædia, London, 1870, p. 53. For Dr. Dwight, see The New-Englander, vol. xvi, p. 465. For the theological article referred to as giving up the sacred theory, see the Cyclopædia of Biblical, Theological, and Ecclesiastical Literature, prepared by Rev. John McClintock, D. D., and James Strong, New York, 1873, vol. v, p. 233. For Arabic as an earlier Semitic development than Hebrew, as well as for much other valuable information on the questions recently raised, see article Hebrew, by W. R. Smith, in the latest edition of the Encyclopædia Britannica. For quotation from Canon Farrar, see his Language and Languages, London, 1878, pp. 6, 7.

brought together within the covers of the Bible. What matters it that those who incorporated the Creation lore of Babylonia and other Oriental nations into the sacred books of the Hebrews, mixed it with their own conceptions and deductions? What matters it that Darwin changed the whole aspect of our Creation myths; that Lyell and his compeers placed the Hebrew story of Creation and of the Deluge of Noah among legends; that Copernicus put an end to the literal acceptance of the standing still of the sun for Joshua; that Halley, in promulgating his law of comets, put an end to the doctrine of signs and wonders; that Pinel, in showing that all insanity is physical disease, relegated to the realm of mythology the witch of Endor and all stories of demoniacal possession; that the Rev. Dr. Schaff, and a multitude of recent Christian travelers in Palestine, have put into the realm of legend the story of Lot's wife transformed into a pillar of salt; that the anthropologists, by showing how man has risen everywhere from low and brutal beginnings, have destroyed the whole theological theory of "the fall of man"? Our great body of sacred literature is thereby only made more and more valuable to us: more and more we see how long and patiently the forces in the universe which make for righteousness have been acting in and upon mankind through the only agencies fitted for such work in the earliest ages of the world—through myth, legend, parable, and poem.

THE DEVELOPMENT OF AMERICAN INDUSTRIES SINCE COLUMBUS.

III. IRON-SMELTING BY MODERN METHODS.

By WILLIAM F. DURFEE, Engineer.

THUS far in these papers we have dealt only with iron smelted by charcoal, and, in fact, up to the year 1830, there had been no attempt whatever to utilize either anthracite or bituminous coal for the purpose. In regard to the use of mineral coal Swank quotes as follows from a letter dated March 18, 1825, from the acting committee of the Pennsylvania Society for the Promotion of Internal Improvements to William Strikeland, who was its European agent: "No improvements have been made here in it [the manufacture of iron] within the last thirty years, and *the use of bituminous and anthracite coal in our furnaces is absolutely and entirely unknown.* Attempts, and of the most costly kind, have been made to use the coal of the western part of our State in the production of iron. Furnaces have been constructed according to the plan *said* to be adopted in Wales and elsewhere; persons claiming experience in the business have been employed; but all has been unsuccessful."

In the year 1835 the Franklin Institute offered a gold medal "to the person who shall manufacture in the United States the greatest quantity of iron from the ore during the year, using no other fuel than anthracite coal, the quantity to be not less than twenty tons." This medal was never awarded, and it is fair to presume that the required quantity of iron was not manufactured by any one person in 1835 by "using no other fuel than anthracite coal." Nevertheless, there is abundant evidence to prove that from the year 1830 to the year 1840 there were a number of attempts to use mineral fuel for the smelting of iron-ores.

The most successful of these experiments was tried at Pottsville, Pa., and the works were called the Pioneer Furnace. It was built for Burd Patterson, by William Lyman, of Boston, and blast was unsuccessfully applied July 10, 1839, but the furnace was finally successfully blown in by Benjamin Perry, October 19, 1839, and produced twenty-eight tons per week of good foundry iron. "This furnace," say Bishop, "made a continuous blast of ninety days, and secured for its proprietor a premium of $5,000 which had been subscribed by citizens of the State." On June 5, 1839, Mr. David Thomas, who had been associated with Mr. George Crane in making pig iron with anthracite coal at Yniscedwin, in Wales, arrived in America, and on July 9th of the same year he commenced the erection of the first furnace of the Lehigh Crane Iron Company at Catasauqua, Pa. This furnace was successfully blown in by him on the 3d of July, 1840, and the first "cast" was made on July 4th. The furnace was provided with a hot blast, and was blown by water power derived from the Lehigh Canal. This enterprise was a success from the start, the furnace producing fifty tons of good foundry iron per week, and it continued to be profitably operated until 1879, when it was torn down. Notwithstanding the fact that there were several promising experimental attempts to smelt iron with anthracite coal prior to the erection of a furnace at Catasauqua by Mr. Thomas, yet this furnace, from its large initial output (as measured by the practice of the time) and continuous operation, and the fact that it pointed out clearly the essential requisites of success in smelting with anthracite coal—viz., large capacity of furnace, supplied with abundance of blast at a high temperature*—may fairly be considered the first furnace in America that achieved a satisfactory commercial success in making iron with anthracite as a fuel. From his success in the erection and operation of this furnace, and subsequent life-long identification with the manufacture of anthracite pig iron, on a scale far surpassing any of his contemporaries, Mr. Thomas is fairly entitled to be called the father of the anthracite iron industry of

* The "hot blast" was invented by James Beaumont Neilson, of Glasgow, in 1828.

America. He died at Catasauqua on June 20, 1882, in his eighty-eighth year.

Fig. 31 is a view of the first furnace erected at Catasauqua by Mr. Thomas.* This furnace was about forty feet square at the base and forty feet high; it was twelve feet internal diameter at the "boshes," and was lined with nine-inch fire-brick brought from Risca, in Wales. The hearth was four feet square. At first the "hot-blast stoves" were on the ground and fired with coal; they were three in number, and each contained two "bed pipes," connected by ten semicircular "siphon pipes." Each "stove" had a fire-grate at one end, and at the other was a chimney provided

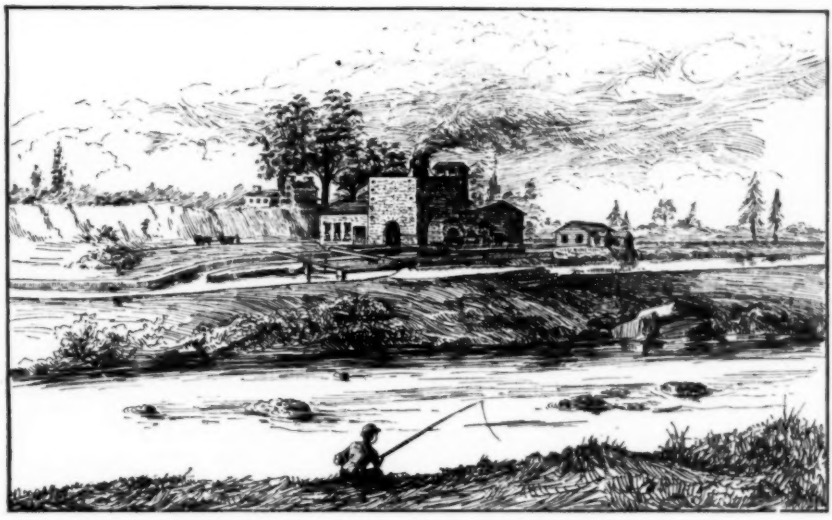

FIG. 31.—EARLY ANTHRACITE IRON-FURNACE AT CATASAUQUA.

with a damper at its top. The gas escaped freely at the "tunnel-head," and was, of course, wasted. The first blowing machinery comprised a "breast" water-wheel, twenty-five feet long and twelve feet in diameter; this operated two blowing cylinders five feet in diameter and six feet stroke. At first the pressure of blast was only about a pound and a half, but the following year another water-wheel of the same size was added, after which the pressure of blast was increased to two pounds and a half per square inch. The head and fall of the water-supply was eight

* Diligent inquiry failed to discover any photograph or engraving of this furnace; but from some plans and elevations, combined with explanatory information kindly furnished by John Thomas, Esq., Superintendent of the Thomas Iron Works, Hokendauqua, Pa., together with information obtained from Oliver Williams, Esq., President of Catasauqua Manufacturing Company, during a visit to the site of the old furnace, a pen-and-ink drawing was made by the writer, from which the above engraving was reduced. It is said to give a very correct idea of the furnace and its surroundings.

feet, the "head-race" taking its water from above the lock opposite the furnace, and the "tail-race" discharging into the lower level of the canal, below the lock. With one water-wheel the "make" of iron was only about twenty-five to thirty tons per week, but with the second wheel the production was increased to upward of forty tons, varying, of course, with the condition of the water-supply, and sometimes reaching sixty to seventy tons. In years afterward this furnace, with still more powerful blowing machinery, made one hundred and seventy-two tons of iron in a week. The furnace was filled by a water hoist, consisting of two "tubs" about six feet square, suspended to a chain passing over a large pulley at the top of the hoist tower; the tops of these tubs

FIG. 32.—A CHARCOAL BLAST-FURNACE.

were covered and formed platforms on which the barrows were raised. By letting the water out of the tub that chanced to be at the bottom of the tower, the weight of water in the tub at the top caused it to descend, thus raising the other tub with its load. In order to operate this hoist, it was necessary to have a water-supply at the top of the furnace to fill the tub that was at the top.

At first nothing but the coal was dumped into the furnace, the ore and limestone being charged with iron pans similar to the baskets formerly used at charcoal furnaces; the limestone was broken quite small.

After the success of this furnace was assured, furnaces in which mineral fuel (either anthracite or coke, or a mixture of the two, with an occasional use of raw bituminous coal) was exclusively used rapidly increased. Various changes and improvements naturally took place as time passed and experience was gained; but year by year the volume of iron smelted by mineral fuel increased relative to that made by charcoal, until in 1889 it reached the grand total of 7,871,779 tons, while "the make" of the charcoal furnaces amounted to but 644,300 tons.*

Notwithstanding the practical demonstration by David Thomas that mineral coal could be successfully used for smelting iron, charcoal furnaces continued to be built. The general appearance of such furnaces as were erected during the fifteen years following the year 1840 is well represented in Fig. 32, of which Fig. 33 is a vertical section. As a rule they were no better in idea, and but little in execution, than those described by Swedenborg a century before; but, after the year 1855, the construction of furnaces began to receive more careful attention, and by the year 1860 the best-informed metallurgical engineers (whose profession was just beginning to be recognized) had discovered that uncouth bulk and crude workmanship were not desirable features in a furnace for the making of pig iron. Yet, nevertheless, some of the stragglers who are always found hovering in the rear of the grand army of progress, and who never know what is going on at the

* Nevertheless, the actual total production of charcoal iron is found to be increasing, as there were but 348,954 tons made in 1856, little more than half the product of 1889. The modern charcoal furnace produces much more iron per year than those constructed thirty-four years ago. The total output of charcoal iron for 1889 was made in 63 furnaces, which would require an average annual production of 10,227 tons per furnace; while in 1856 the total output of charcoal iron came from 416 furnaces, which therefore produced an annual average of but 838 tons per furnace. This calculation is based upon the supposition that all the furnaces reported in 1856 were in operation. Of this there is a little uncertainty; but, after making the most liberal allowance for this, it is still evident that the average annual output of the modern charcoal furnace is many times greater than that of the furnace as constructed in 1856.

A similar calculation applied to the production of anthracite iron (including that made with a mixture of anthracite and coke) shows that in 1889 each furnace produced 18,465 tons of iron, while in 1856 each furnace made but 3,268 tons, or, in other words, the furnace of to-day produces $5\frac{6}{10}$ times as much as that erected thirty-four years ago.

By a comparison of the old bituminous and coke furnaces with those of our time using the same fuels, we learn that in 1856 the average annual output of this class of furnace was 1,617 tons, and that in 1889 the average make of the bituminous and coke furnaces was 34,188 tons. From these figures it appears that the furnaces of 1889 were twenty-one times more productive than those of 1856.

front, built furnaces, as late as 1864, that, when measured by the standard of the available knowledge of the time, were little better than ponderous aggregations of ignorance and masonry.

Among the earlier of the many improvements in the details of blast-furnace construction and management, which were made in consequence of the employment of mineral coal for smelting, was

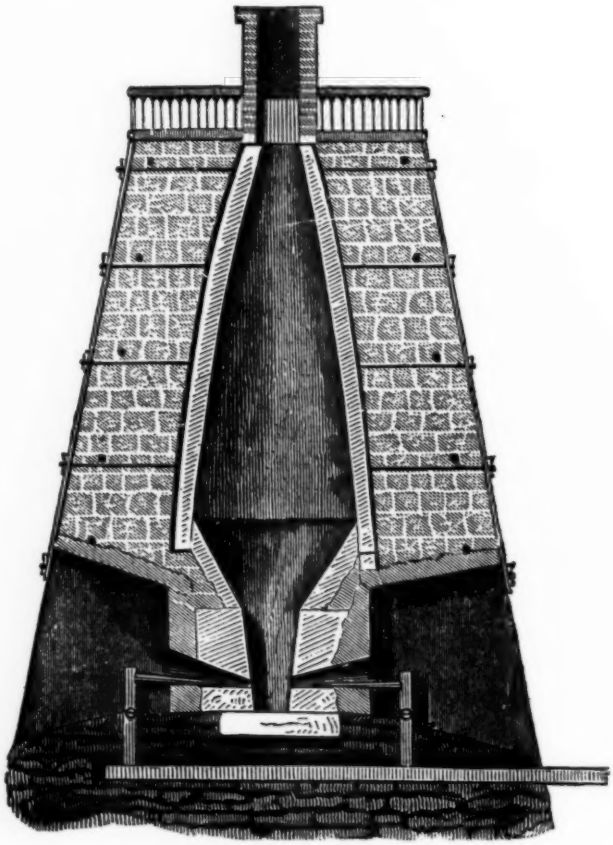

FIG. 33.—VERTICAL SECTION OF A CHARCOAL BLAST-FURNACE.

the substitution of blowing cylinders of iron for the wooden blowing apparatus previously employed in connection with charcoal furnaces. One of the simplest forms of iron blowing machinery is shown in Fig. 34. This apparatus consisted of two vertical "blowing cylinders," provided with appropriate valves, through which the air was drawn in and discharged into a "wind-chest" by the vertical reciprocation of a piston in each cylinder. These pistons were actuated by the cranks on the gear-wheel shown, through the intervention of suitable connecting-rods and walking-beams. The cut (Fig. 34) conveys only the simplest form of

the idea embodied in the walking-beam blowing-engine, and is very far from adequately representing the latest exemplification of that idea, as carried out in the colossal machines employed to blow many of the largest modern furnaces.

There is great variety in the construction of blast-heating apparatus, but it can be comprehensively described as consisting of

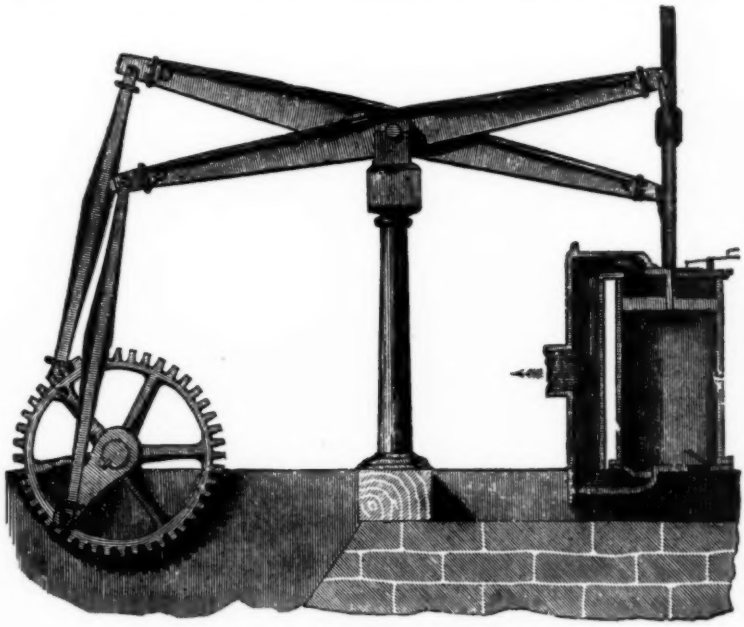

FIG. 34.—IRON BLOWING-ENGINE.

two well-defined types: (1) those forms in which the air is heated by passing through hot iron pipes, inclosed in a brick chamber or "oven"; (2) those forms in which the blast is heated by actual contact with red-hot masses of brick-work inclosed in air-tight chambers. Fig. 35 is a vertical longitudinal section, and Fig. 36 a vertical transverse section, of one of the best of the many forms of the first-named type of "hot-blast stove." This construction of "stove" was the invention of John Player, of England, who introduced it to the notice of American iron-masters in 1867; and the first "Player stove" in the United States was erected at the anthracite furnace of J. B. Moorehead & Co., at West Conshohocken, Pa. Before Mr. Player came to America it had been the usual though not universal practice to place the gas-fired "hot-blast stoves," as well as steam-boilers, on the same level as the top of the furnace, but in all the furnaces erected by him he placed the "hot-blast stoves" and the boilers on the ground, and brought the gas down to them in a large pipe or "down-comer" as it was called.

The "Player stove" was provided at its base with a large "combustion chamber" (see Fig. 35), into which the gas entered, and there meeting with sufficient air for its combustion, the resulting heated gases passed upward through flues (indicated by the arrows *s*, *s*, *s*) in the roof of the "combustion chamber" into the "pipe chamber" above. In this chamber were arranged a series of vertical "siphon pipes," standing upon hollow bases or

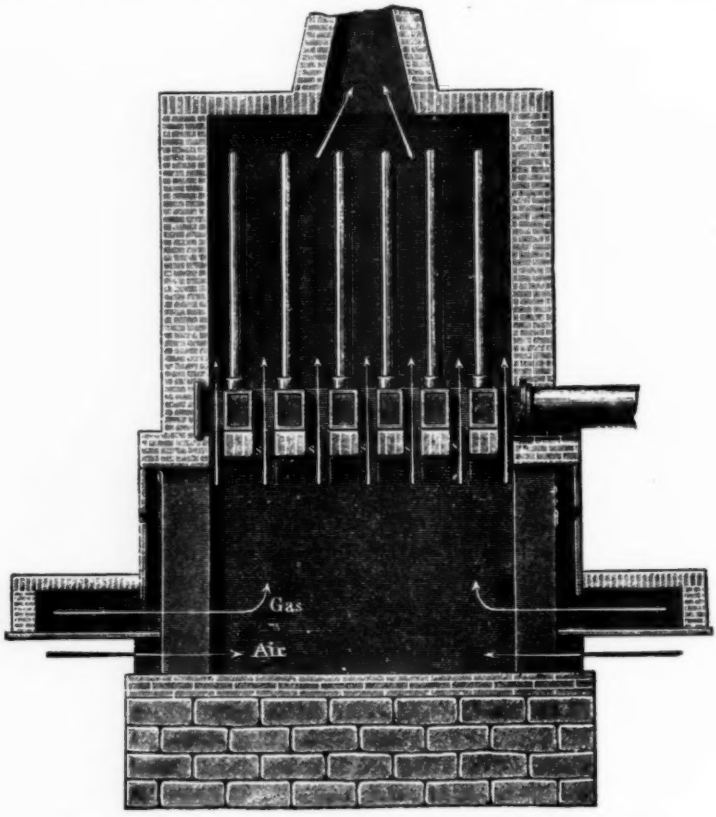

FIG. 35.—LONGITUDINAL SECTION OF THE PLAYER HOT-BLAST STOVE.

"bed pipes" of cast iron. The air to be heated was admitted to the right-hand bed pipe B (Fig. 36), and passed thence in the direction of the arrows through the siphon pipes into the left-hand bed pipe B′, from one end of which it was taken in suitable pipes to the furnace. The introduction of the "Player stove" was the means of greatly increasing the production of iron in the furnaces to which they were applied, and at the same time the amount of fuel required per ton of iron was diminished; further economies were realized by increasing the size of furnaces, and the power of the engines that supplied them with blast.

The first example of the second type of hot-blast stove erected

in America was put in operation June 18, 1875, at Rising Fawn Furnace, in Dade County, Ga. The particular construction there used was that invented in England by Thomas Whitwell. Its general idea involved a cylindrical air-tight chamber of boiler iron lined with fire-brick; this chamber was traversed by a number of vertical parallel walls or diaphragms, also of fire-brick. The operation of this stove was as follows, viz.: The whole interior was heated to a very high temperature by means of the waste gas of the furnace which passed through the stove in the spaces between the fire-brick diaphragms. As soon as the stove was sufficiently heated the gas was turned off, and the blast was forced through the stove; and, as it traversed the spaces between the fire-brick walls on its way to the furnace, it absorbed heat from them and consequently reduced their temperature. This alternate heating and cooling of the stove, by the passage for a certain time, first of ignited gas, and then by the air to be heated, could be so regulated by suitable valves that a temperature of blast could be attained much higher than was possible in an iron-pipe stove. In order to insure regularity of working and uniformity of heat, it is usual to have at least three (some furnaces have four, and in Europe five have been used) such stoves to each furnace.

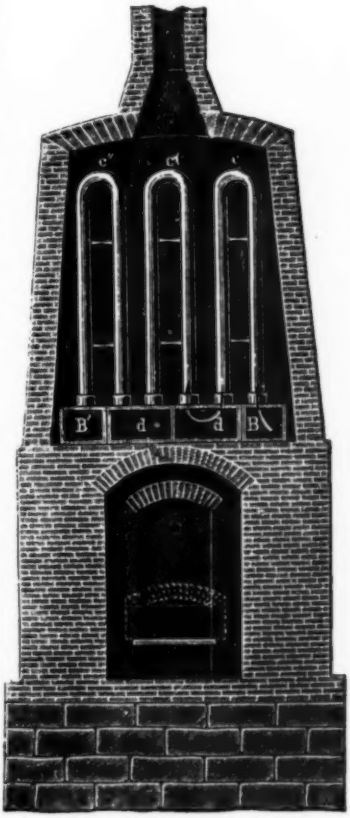

FIG. 36.—TRANSVERSE SECTION OF THE PLAYER STOVE.

Besides the Whitwell stove, there are at present a number of others of the second type in use, whose details differ somewhat, but they all have an air-tight chamber lined with fire-brick, as a common constructive feature; this chamber is filled with partitions, blocks, tubes, and perforated or loose brick, in a great variety of ways, for each of which is claimed peculiar merit by its inventor; but it is quite evident that the design of some of these stoves was inspired by the desire to avoid the consequences of infringing existing patents on tweedle-dum by constructing tweedle-dee.

A good idea of the internal arrangement of a Siemens-Cow-

per-Cochrane Stove* is conveyed by Fig. 37, in which the burning gases intensely heat the reticulated mass of fire-bricks B B, which in turn heat the air of the blast. All the fire-brick stoves are of such huge proportions that a modern furnace plant suggests a hot-blast apparatus with an attached furnace, rather than a furnace with hot-blast stoves.

Raw bituminous coal has been used to some considerable extent as a blast-furnace fuel since 1845, near the end of which year Mr. David Himrod (late of Youngstown, Ohio) used raw coal for a time with success in a furnace on Anderson's Run, Mercer County, Pa. This furnace had been "blown in" with charcoal, but the available quantity of this fuel being insufficient, some coke was mixed with it, and later raw coal was substituted for the coke; and we are told that "the furnace worked well and produced a fair quality of metal." The first furnace in America built with the intention of using raw bituminous coal as fuel was built in 1845 for Messrs. Wilkinson, Wilkes & Co., at Lowell, Mahoning County, Ohio. This furnace was successfully blown in with raw coal on the 8th of August, 1846, by John Crowther, an Englishman, who came to the United States in 1844, previous to which he had been the manager of seven furnaces in Staffordshire. Mr. Crowther adapted many furnaces in Ohio to the use of bituminous coal, and instructed his three sons, Joshua, Joseph J., and Benjamin, in their management. He died April 15, 1861, in England. The successful blowing in of the furnace at Lowell may be fairly

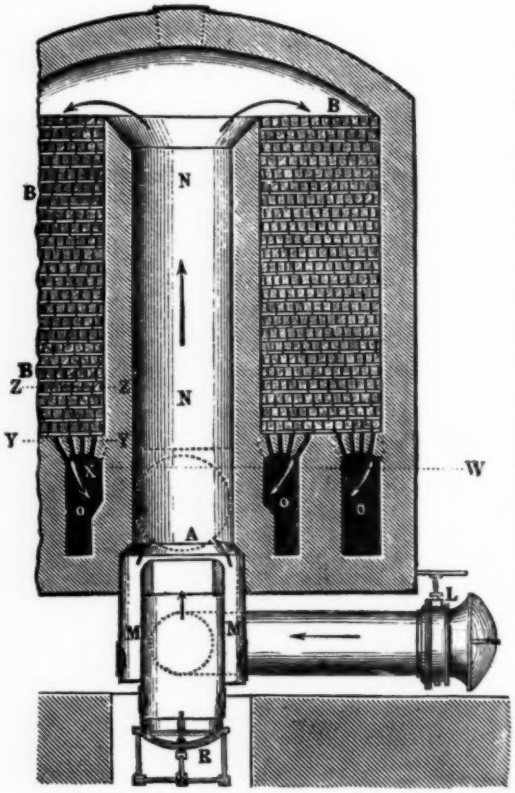

FIG. 37.—THE SIEMENS-COWPER-COCHRANE HOT-BLAST STOVE.

* Invented by Dr. C. W. Siemens, Edward W. Cowper, and Charles Cochrane.

regarded as the commencement of the use of raw bituminous coal as a blast-furnace fuel in the United States.

Coke is the fuel by which over one half of the pig iron made in America at the present time is smelted.* The first public mention of coke as a possible substitute for charcoal in American blast-furnaces is contained in an advertisement which appeared in the Pittsburg Mercury of May 27, 1813. This is quoted by Weeks,† as follows, viz.:

"*To Proprietors of Blast-furnaces:*

"John Beal, lately from England, being informed that all the blast-furnaces are in the habit of melting iron-ore with charcoal, and knowing the great disadvantage it is to proprietors, is induced to offer his services to instruct them in the method of converting stone coal into *coak*. The advantage of using coak will be so great that it can not fail to become general if put to practice. He flatters himself that he has had all the experience that is necessary in the above branch to give satisfaction to those who feel inclined to alter their mode of melting their ore.

"JOHN BEAL, *Iron Founder.*

"N. B.—A line directed to the subscriber, post-paid, will be duly attended to."

There is no evidence that Mr. Beal was ever called upon to "instruct" the Pittsburg iron-masters of seventy-seven years ago in the art and mystery of making "*coak*," but doubtless his advertisement may have stimulated inquiring minds; for, four years after its appearance, we find that Colonel Isaac Meason used coke in the "refinery" of his mill at Plumsock, Fayette County, Pa. This mill went into operation in September, 1817, and it was the first mill west of the Alleghany Mountains in which iron was puddled and rolled into bars. Weeks, speaking of the use of coke in this mill, says, "This is the first definite statement that I have been able to find of the use of coke in this country." A short time after this first use of coke in America there were several attempts to employ it in a blast-furnace, but there is no record of any success in this direction until the building of the Lonaconing furnace, Alleghany County, Md., in 1837. This fur-

* This fact is a good illustration of the realization of great value from a material that was at first regarded with disfavor. Overman, writing in 1849 (The Manufacture of Iron, p. 179), says: "As we have previously remarked, there is but little prospect of seeing coke furnaces in successful operation in the United States. Nearly every State in the Union has good raw coal in sufficient quantity, as well as of proper quality, to supply its furnaces."

† Report on the Manufacture of Coke. By Joseph D. Weeks, Special Agent. New York: David Williams, 1385.

nace was (according to Overman *), "the first coke furnace whose operation was successful erected in this country. It is fifty feet high, fifty feet at the base, twenty-five feet at the top, and measures fifteen feet at the boshes." † In 1840 two large blast-furnaces were built by the Mount Savage Iron Company, at Mount Savage, Md. These furnaces also used coke, of which there was made, "from 1840 to 1850, between 50,000 and 75,000 tons"—"most of which was used at the furnaces." ‡ All the coke for the above furnaces was made in pits.

The manufacture of "Connellsville coke," which is regarded as especially excellent for smelting iron, was commenced in 1841. Weeks (writing in 1883) gives the following account of the beginning of the coke business in the Connellsville region: "Two carpenters, Provance McCormick and James Campbell, overheard an Englishman, so the story runs, commenting on the rich deposits of coal at Connellsville, and their fitness for making coke, as well as the value of coke for foundry purposes, and they determined to enter upon its manufacture. Mr. McCormick, who is still living, an old man of eighty-four, has given me an account from memory of this enterprise which I quote: 'James Campbell and myself heard, in some way that I do not now recollect, that the manufacturing of coke might be made a good business. Mr. John Taylor, a stone-mason, who owned a farm on which the Fayette Coke-works now stand, and who was mining coal in a small way, was spoken to regarding our enterprise, and proposed a partnership—he to build the ovens and make the coke, and Mr. Campbell and myself to build a boat and take the coke to Cincinnati, where we heard there was a good demand. This was in 1841. Mr. Taylor built two ovens. I think they were about ten feet in diameter. My recollection is that the charge was eighty bushels. The ovens were built in the same style as those now used, but had no iron ring at the top to prevent the brick from falling in when filling the oven with coal, nor had we any iron frames at the mouth where the coke was drawn. In the spring of 1842 enough coke had been made to fill two boats ninety feet long—about eight hundred bushels in each—and we took them to Cincinnati, down the Youghiogheny, Monongahela, and Ohio; but when we got there we could not sell. Mr. Campbell, who went with the boats, lay at the landing some two or three weeks, retailing one boatload and part of the other in small lots at about eight cents a bushel. Miles Greenwood, a foundryman of that city, offered to

* The Manufacture of Iron in all its Various Branches, etc. By Frederick Overman, Mining Engineer. Philadelphia: Henry C. Baird, 1850.

† A good example of the phenomenally clumsy construction thought to be essential to successful working at that time.

‡ Weeks's Manufacture of Coke.

take the balance if we would take a small patent flour-mill at $125 in pay, which Mr. Campbell did. He shipped it here. We tried it, but it was no good, and we sold it to a man in the mountains for $30; and thus ended our coke business.' These gentlemen lost heavily in their venture. It was not until the Baltimore and Ohio Railroad was completed to Pittsburg, and Connellsville coke had been used successfully in the Clinton Furnace of Graff, Bennett & Co., at Pittsburg, that its value as a furnace fuel was thoroughly demonstrated and the foundation laid for the demand that has resulted in such a development of the coke manufacture in the Connellsville region. This furnace was blown in, in the fall of 1859. The coke was at first made from Pittsburg coal, near the furnace on the south side of the Monongahela River, nearly opposite the Point, at Pittsburg. The furnace was run for about three months, when, the coke made in this way not proving satisfactory, it was blown out, and arrangements made to secure a supply from the Connellsville region. The furnace blew in again early in the spring of 1860, the coke used being from the Fayette Coke-works on the Baltimore and Ohio Railroad, made at first on the ground in pits. The result was so satisfactory that thirty ovens were built in 1860, and arrangements were made to secure a continued supply."

The general tendency toward improvement in all branches of manufacturing that began to manifest itself in America about the year 1840, and which, fortunately for the welfare of the country, has grown with the years and strengthened with each new triumph of inventive thought, prompted investigation with a view to determine what constructive ideas were really essential to the building of a thoroughly efficient blast-furnace in which coke was to be used as the fuel; and it was very soon ascertained that European metallurgical engineers had discovered that it was not at all necessary to purchase a stone quarry before commencing the erection of a furnace, and that all the functions of successful smelting could be performed in a structure consisting substantially of a sheet-iron casing lined with fire-brick, supported upon cast-iron columns, between which were the *tuyères* and dam, which were thus rendered readily accessible; the furnace being entirely unincumbered with ponderous masses of supporting masonry. This form of furnace was not a creation, but the result of a gradual evolution from the old truncated pyramidal structure whose massive proportions were ignorantly supposed to be absolutely necessary, not only to support the weight of ore and fuel, but also to confine the heat in the furnace. The first deviation from the old construction consisted in a reduction of the quantity of material used by making all that part of the furnace above the *tuyère* arches either cylindrical or conical, and binding it with iron

hoops; the lower portion remaining quite as massive as had been customary.

The next stage in the evolution made the whole furnace a frustum of a cone pierced at the base by four or more arches, that portion above the arches being hooped. The next change in construction consisted in casing the whole furnace, sustaining piers as well as the part above, in boiler iron. This construction was followed by the removal of the piers altogether, the upper conical portion of the furnace being built of cut stone hooped with iron and supported on cast-iron columns. Fig. 38 is an elevation and Fig. 39 a vertical section of one of the earlier furnaces of this con-

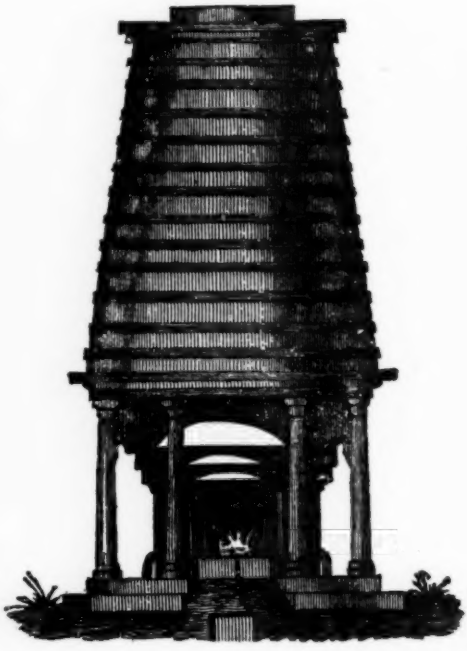

FIG. 38.—AN EARLY FRENCH COKE BLAST-FURNACE.

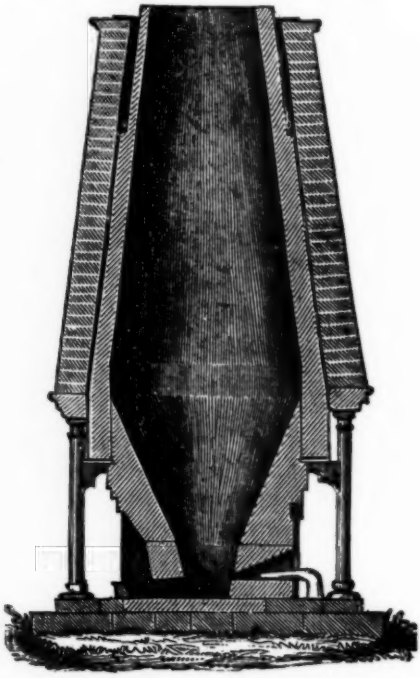

FIG. 39.—SECTION OF FRENCH COKE BLAST-FURNACE.

struction. There were three such furnaces built at Hyanges, department of Moselle, France, prior to the year 1849 (probably in 1845). These furnaces were forty-six feet high and sixteen feet in diameter at the "boshes" and eight feet at the top. They were built expressly for the use of coke, and, according to Overman, they "worked admirably."

The study of the construction and operation of such furnaces as these doubtless had its influence in determining the details of the Clinton Furnace of Graff, Bennett & Co., of Pittsburg, already referred to as having been the first to use "Connellsville coke" with success. This furnace, which I visited in January, 1863, was

"simply a jacket" of boiler iron lined with fire-brick. It was fifty feet high and twelve feet "bosh."

The make of iron was twenty tons in twenty-four hours. Since the date of the erection of this furnace, which at the time was the only blast-furnace in Alleghany County (in which Pittsburg is situated), Pennsylvania, there have been built within its territory twenty-four coke furnaces, which produced in 1889 "more pig iron than the whole State of Ohio; more than twice as much as Illinois; and more than one seventh of the country's total production."*

The furnaces have not only increased in number, but their size and output have been very much augmented. As an illustration of this, furnace "F," of the "Edgar Thomson Steel Works," is eighty feet high, twenty-two feet diameter at the "boshes," eleven feet diameter of hearth, sixteen feet in diameter at the throat, and has a capacity of 18,000 cubic feet. This furnace produces 10,603 gross tons of iron per month (351 tons per day) on a fuel consumption of 1,756 pounds (coke) per gross ton. The pressure of blast at the *tuyères* is nine pounds per square inch, and its volume 25,000 cubic feet per minute, heated to 1,200° Fahrenheit.†

While the iron-masters west of the Alleghany Mountains were increasing the number, size, and economical working of their furnaces, the makers of "anthracite iron" in the Lehigh, Schuylkill, and Susquehanna Valleys were by no means idle; and their furnaces also increased in size and multiplied in number as the years passed. As illustrating the influence of a successful manufacture in drawing population and other industries to its immediate vicinity, no better instance could be selected than the town of Catasauqua, Pennsylvania, where was built in 1840 the furnace described in the first part of this article. Where then was but a single furnace, a small number of scattered houses, and a few score of people, we now find five furnaces, two rolling-mills, and a number of collateral industrial establishments, giving sustenance to a large and busy population. Fig. 40 is a view of the present blast-furnace plant at Catasauqua.‡ For the purpose of showing

* Annual Report of James M. Swank, Esq., General Manager of the American Iron and Steel Association, for the Year 1889.

† For these details I am indebted to the courtesy of James Gayley, Esq., Superintendent of Furnaces of the Edgar Thomson Steel Works.

‡ This view was taken looking diagonally up the Lehigh River; but in that of the old furnace (see Fig. 31) the spectator is supposed to be looking diagonally down the river, which in Fig. 40 is in front, and just without the limits of the picture. The Lehigh Canal, which is plainly seen in Fig. 31, is in Fig. 40 between the line of railway and the furnace buildings. The canal lock (shown in Fig. 31) is at the left of the picture, its lock-house being seen among the trees. The original furnace (1840) was located very near the large building, having a curved roof, on the end of which is the sign of the "Crane Iron Works." Nearly all the foreground, occupied by piles of pig iron, has been filled in since 1840.

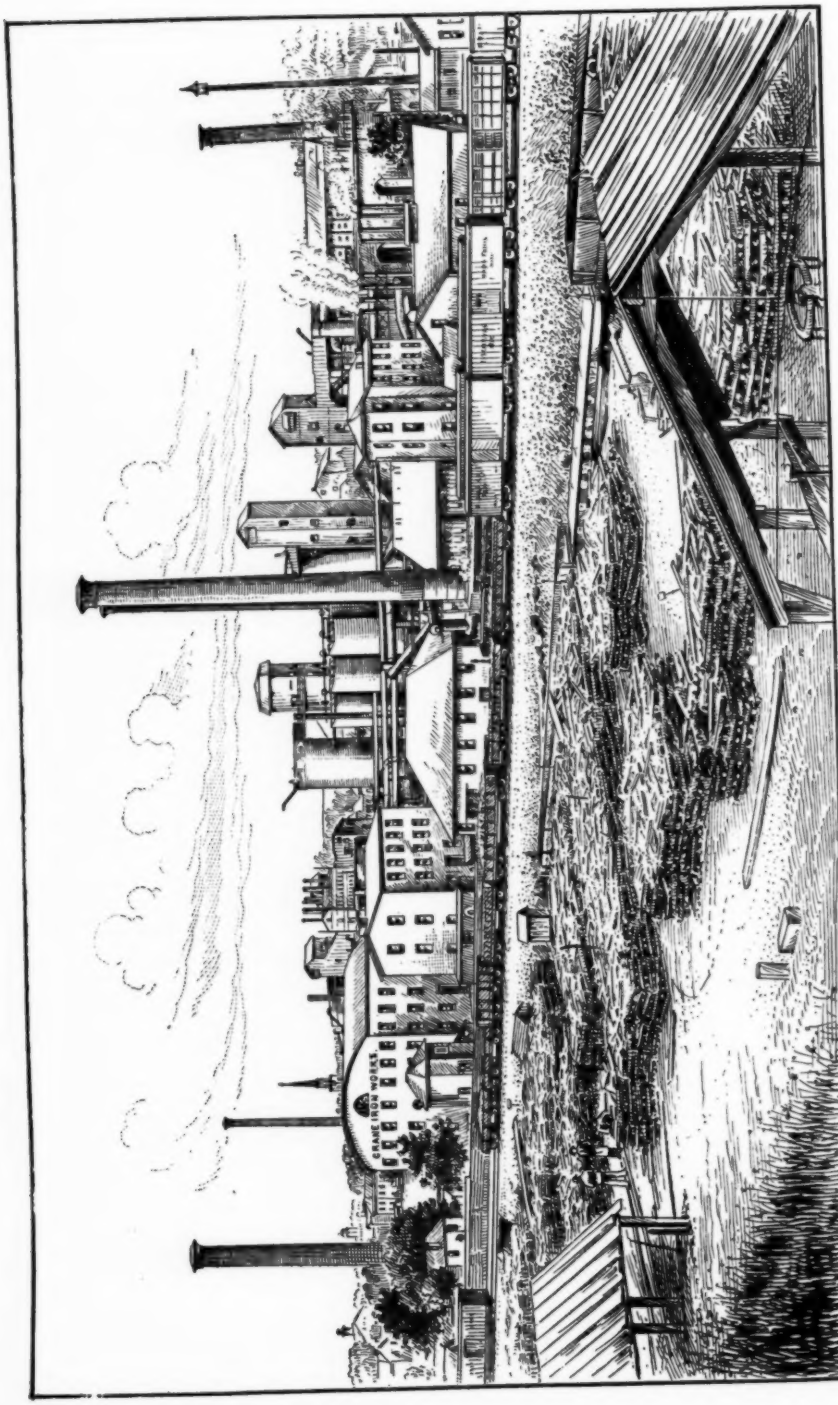

FIG. 40.—IRON WORKS AT CATASAUQUA.

at what rate the technology of the manufacture of anthracite iron has advanced during these years, we will compare the product of the furnace of 1840 with that of the furnaces on the same ground at the present time. The original furnace made in the year ending July 1, 1841, 2,460 tons; and the present plant (five furnaces) produced during the year ending July 1, 1890, 111,828 tons, or at the rate of 22,365 tons per furnace (on the supposition that they were all running), which is more than nine times the product of the furnace built in 1840 at that place.

The production of pig iron in the United States for the year ending June 30, 1890, was the largest in the history of the country, and, in fact, larger than that of any other nation in the world, being 258,216 tons in excess of the production of Great Britain in 1889. The following table exhibits the rate of increase of production of pig iron during the past twenty years:*

DISTRICTS.	Tons of 2,000 pounds.		
	Year ending May 31, 1870.	Year ending May 31, 1880.	Year ending June 30, 1890.
New England States	34,471	30,957	33,781
Middle States	1,311,649	2,401,093	5,216,591
Southern States	184,540	350,436	1,780,909
Western States	522,161	995,335	2,522,351
Far Western States	.....	3,200	26,147
Totals	2,052,821	3,781,021	9,579,779

From the above figures we see that the manufacture of pig iron in New England has been practically stationary for the past twenty years, while in the Middle States it has nearly quadrupled, in the Western States it has increased nearly five times,† and in the Southern States nearly ten times in the same period.

Few persons save those connected with the manufacture of pig iron are aware of the enormous and insatiable appetite of one of the largest blast-furnaces; and the figures hitherto given fail to convey an adequate idea of the immense quantity of materials that pass through such a furnace, and it is only when the total daily amount of these materials is considered that the tremendous igneous activities constantly at work in that combination of hurricane and volcano—a modern blast-furnace of the first class—

* For this table and other facts relative to the output of pig iron in this country I am indebted to the report of Dr. William M. Sweet to Robert P. Porter, Superintendent of Census for 1890:

† A large proportion of this increase has been manufactured in Chicago and its immediate vicinity. This fact is confirmatory of a belief that the writer has entertained for many years, that Chicago was destined to be one of the important centers of the iron and steel manufacture of this country.

can be fully appreciated. Such a furnace will have passed through it in twenty-four hours the following materials:

Ore	1,263,360	pounds	or	564	gross	tons.
Coke	990,384	"	"	442	"	"
Limestone	353,741	"	"	158	"	"
Atmospheric air (blast)	2,331,840	"	"	1,041	"	"
Totals	4,939,325	"	"	2,205	"	"

which is equal to ninety-two tons per hour, or 1·53 tons per minute.* From this quantity of materials there will be produced in twenty-four hours 784,000 pounds or 350 gross tons of pig iron, which is at the rate of 32,666 pounds or 14·57 tons per hour, or 544 pounds per minute.

Heating the 25,000 cubic feet of air supplied per minute to a temperature of 1,200° Fahr., its volume would be increased to 85,000 cubic feet; and, on the supposition that the furnace is blown by seven *tuyères*, each seven inches in diameter, this torrid air would rush through each *tuyère* (under a pressure of nine pounds per square inch) at the rate of 12,143 cubic feet, and having the enormous lineal velocity of 45,417 feet per minute. This velocity is over five times that of the most violent tornadoes, and the pressure is more than twenty-five times greater. Should a blast of equal pressure and velocity come from unfathomed space and envelop this earth, it is absolutely certain that no living beings or loose materials would be left upon its rock-ribbed skeleton, which, stripped of its flesh and blood, fields and forests, lakes and oceans, would be hurled into a new orbit and made to assume revolutions and rotations whose amplitude and duration it is impossible to imagine or describe.

[*To be continued.*]

A CONTRIBUTION has been made to the speculations respecting the relative growth of the white and colored population of the United States by Quartermaster-General Meigs, who has published tables exhibiting the increase of both, by decades, since 1790. They show that the total population had increased eightfold in 1860; while the average increase of whites by decades was 32·8 per cent, and of negroes 26·8 per cent. In 1790, there were 3,172,000 more whites than negroes; in 1880, 48,575,000; in 1890, probably 58,640,000 more; and if the present relative rates of increase are maintained, there will be, in 1990, 1,067,043,000 more. The estimate should set the apprehension of negro supremacy a considerable distance away.

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* Perhaps the volume of materials required in the manufacture of pig iron may be more readily comprehended by considering that, for the making of a pound of that commodity from the best ore, there are required 1·612 pounds of ore; 0·786 pound of coke; 0·451 pound of limestone; 2·977 pounds of air, or a total of 5·876 pounds of materials for each pound of iron produced.

PRECISION IN PHYSICAL TRAINING.

By M. GEORGES DEMENY.

THE high aim of science should be, definitely, the physical and moral perfectioning of man. The exercise of the cerebral functions of all ought undoubtedly to be directed from infancy by educators. It is generally agreed that physical education is a necessity of hygiene, but it is not clear to every one that physical education should be subjected to rules and to a precise directing. It is a mistake, in our opinion, to think of getting the best results while neglecting to make scientifically a comparative study of the different methods employed, and while abandoning, as is often the case, the exercises of the body to the caprice of the imagination. There result from this vague condition various currents of opinion contradictory of one another and detrimental to the final result proposed, of ameliorating the physical condition of our population, especially of the population at school, of every degree. Fortunately, the elements of physical education are tangible, its effects are measurable, and we can conduct the discussions on a positive ground on which they fall of themselves. This condition is very different from that of mental education. It is a certain motive for improvement; and we purpose to review the precise means which have contributed to the result. We shall first try to show that it is possible to form a scientific conception of physical education at the present time. We shall then see that the new processes of physiology already permit a satisfactory control of its results.

For a method of education to be established, it is necessary that the end sought be well defined, and the means employed be perfectly adapted to the proposed end and compatible with the human organization. The indisputable object of education should be the perfecting of the individual in view of the general progress; it is an economical object, having as its consequence a much greater conversion of human activity into useful work. In physical education it is necessary to apply all the general knowledge we possess concerning the relations between the function and the organ, or rather concerning the modifications endured by the organs, of which we modify the function.

All the ideas acquired by trainers are to be carefully collected; and among modifiers of species, selection must be placed in the first line. Unfortunately, we are still far from the thought of applying to ourselves this powerful agent for improvement, although we impose it on our domestic animals; our own unions are not often made in view of the inheritance of vigor and health which we shall leave to our descendants.

Selection put aside, we have recourse only to exercise and *régime*. The desire to make an athlete of every one must, of necessity, be abandoned. The ideal human type varies with the times; now it is intellectual activity that is in dominant force, and it is not possible to bring muscular work and cerebral work to the front with equal vigor. Physiological knowledge on this subject is extensive enough for us to account for the fact. Cerebral labor is a considerable expenditure of energy, a source of nervous exhaustion quite comparable to the expenditure of energy that accompanies the production of mechanical labor in the muscles; whence we conceive that, beyond a certain amount of physical exercise regulated by hygiene, the total sum of the expenditure of nervous and muscular energy may become excessive and entirely debilitating. It is wisdom to abandon the constant practice of violent exercises; to take deliberate measures to restore athletic brutality would be a remedy worse than the disease. It would also be wise to leave uncalled-for and useless exercises to the circus people.

All exercise which, often repeated, tends to modify the external form and adapt the human organism to abnormal machines or movements, to eccentric attitudes, belongs to the domain of the acrobat, and is of no interest in view of general education. We thus arrive, by elimination, at the point of preserving as materials of the programmes of physical education the general measures which augment the productiveness of man considered as a source of mechanical work, on the condition that those measures do not deteriorate the human machine itself, and do not change the normal relations of that which it has been agreed to call the physical and the moral. Physical education, in short, ought to confirm health, give a harmonious development to the body, and teach how best to utilize the muscular force in the different applications which are demanded in life. We should also have regard to the necessities imposed by the social medium, and try to obtain results by intensive means, requiring little time and little space, and which address a large number at once.

To these three essentials of physical education—health, harmonious development, economical utilization of muscular force—correspond a series of exercises which can not produce their maximum useful effect without being subjected to regulations of which we proceed to sketch the principal features.

Health may be with equal ease confirmed or destroyed by exercise. It is only necessary to refer to the deplorable condition of the ancient athletes, with whom the enormous mass of the muscles absorbed all the activity of the organism. Health, therefore, does not depend on the size of the muscles nor on absolute muscular force. It is the harmony of the functions, and does not

exist without a certain daily expenditure of muscular labor. Many persons, it is true, enjoy perfect health without giving themselves methodically up to physical culture; but such persons are easily disturbed by departures from their regular course, or suffer fatigue disproportionate to the effect produced. They can not endure the causes of perturbation, while it is the power to endure that constitutes robust health. It is one of the great benefits of exercise and of *régime* that they give the organism the faculty of accommodation to the diversities of our activity and of the medium that surrounds us. From the hygienic point of view the introduction into our daily habits of exercise in the open air, in the form of various games and sports, can not be too highly commended; but all such exercises, if we wish to make them always efficacious and exempt from dangers, should be subjected to rule.

We can not prudently leave youth without direction to organize competitions, like the race, in which violent exercises figure; it is indispensable to be on guard against the excesses which unrestrained emulation and self-love induce. Without this, exercises, which are salutary when practiced with moderation, degenerate into overstrain of the most dangerous character. We have in this way to regret numerous grave accidents due to colds, troubles of the digestion and the circulation, falls and blows. Under these restrictions, exercise taken under the form of open-air games presents a special attraction to all; it offers the best hygienic conditions; but, to constitute a physical education, it ought also to respond to the desiderata exposed above—the harmonious development of the body and useful application. Further than this, this form of exercise offers in practice, especially in the large cities, difficulties which are often insurmountable, at least for the present. In public instruction, as now constituted, the problem of physical education is very complex; it involves finding means to exercise regularly every day a large number of pupils at once, in a narrow space and a short time. It is in this shape that the question has been put to the ministerial commission charged with revising the programme and the manual of school gymnastics. Every pupil must receive an equal portion of exercise, and often there is only one master to direct from forty to sixty subjects. Large plats of land are needed near the schools, and often they do not exist. To send the children away through narrow streets crowded with vehicles takes much time, and is dangerous. With all this adjusted, large plats of ground are not enough; ample sheds are needed for open-air exercise. Our climate is not very mild, and if we depend upon the fair days for taking exercise we shall run a great risk of seeing the number of our meetings reduced to an insufficient minimum; for it is not

occasionally, but every day, that we ought to take our portion of exercise. Even putting aside the question of time, it is not hard to show that play-hours do not constitute a complete physical education.

There is exercise in play-hours, but there is not, properly speaking, training of the movements; there is no improvement of these movements in view of a useful effect. Each one does not get the portion of exercise to which he has a right. According to the general law, the strongest or most hardy are more benefited than the weaker ones, and the mean level does not rise. Games and sports are still what they have always been—an elegant means, an agreeable form of exercise, the privilege of the easy class, the pleasure of the smallest number. They can not be extended into the working class which is most interested in them, because it is, unfortunately, often obliged to live in bad hygienic conditions.

Even while it is possible, by means of more perfect facilities for communication, to give the children in our schools more frequent excursions in the open air, such excursions will always be rare—once or twice a week at the most, in the large cities. We shall be obliged on other days to have recourse to the processes of a good gymnastics, mere artificial processes, but which have the advantage of being applicable everywhere, and of producing, in the hands of experienced masters, successful results—an artificial remedy in an artificial medium, if we will call it so, and if we can define precisely the boundary between the natural and the artificial.

Let us, nevertheless, use all our efforts to multiply the public places and shelters for the sole purpose of furnishing children and individuals of every class and every age with places designed for exercise in the open air.

The essential factor of physical education is voluntary motion. From the hygienic point of view it is important to have a sufficient amount of exercise to stimulate the combustion in the interior of the organism, and to facilitate the elimination of the wastes of incomplete combustion, which develop into real poisons. From the point of view of harmonious development, not the amount alone of exercise is to be considered, but the form or nature of the movement also; not the quantity, but the quality, too, of the movement is of importance.

Nothing is more malleable than bone and muscle. Trainers, under the influence of movements frequently repeated, transform domestic species by the action of three great modifiers—selection, alimentation, and exercise; every subject devoted to a well-characterized special calling bears the marks of its calling in its structure. We know, in a general way, that under the influ-

ence of static efforts the body of the muscles becomes thicker and more salient beneath the skin; under the influence of extended movements, on the other hand, the fleshy substance preserves its length and assumes a relation with the amplitude of the movement.

The articular surfaces are also modified by the latter style of practice, and we see how persons who preferably cultivate exercises of suppleness and quickness present a finer and more elegant form than those who develop athletic force by static contractions. With a similar constitution to begin with, those who devote themselves to practice with weights, with carrying burdens, become more massive than those who practice movements of agility, like fencing and racing. The latter come near the type of the ancient gladiator, the former that of Hercules. Which of them do we consider the more handsome?

The idea of beauty is wholly relative, and varies with places and times. Artists make beauty to consist in certain proportions of the parts of the skeleton and in the harmony of the muscular development. We might, perhaps, be more definite by saying that to be handsome at rest and in motion the man ought to present the traits of health and moderate strength, and in addition to be in possession of his means of locomotion and of natural defense. This view of beauty originates in the consideration that there is a necessary relation between vigor, skill, agility, and the outer form of the body at rest and in motion. Thus defined, the type of beauty, in a given race or medium, is an ideal which we seek to revive by physical education. It follows that a man specially devoted to any one exercise can not be handsome. This may be said of all the professions that localize muscular work in a restricted region of the body. There are, however, some sports that have the advantage of exercising equally the upper and lower limbs; such, for example, as wrestling, French boxing, swimming, and canoeing with two oars and a sliding seat. A good gymnastics includes complete exercises, and incomplete or unsymmetrical exercises, under such a condition as that they shall correct one another, and that the work shall bear upon the lower and upper limbs. An intensive gymnastics well taught produces superb subjects. Swedes, Swiss, and Germans, selected from special schools of gymnastics, and the monitors of the school at Joinville le Pont, might rival the finest types of antiquity. These facts are, unhappily, exceptions; children come to our schools with hereditary blemishes and malformations which the sedentary condition, faulty attitudes, and ill-directed exercises only tend to augment.

If we would come near to the type which we have given ourselves as the ideal one, we must make a judicious choice in gym-

nastic matters. The form of the curvings of the vertebral column depends on the action of the weight and of the antagonistic muscles that bend and extend it. There is an evident relation between the curves of the vertebral column and the form of the thorax; with large curvatures correspond depression of the ribs, and enfeebling of the thorax and its consequences—obstruction of the circulation and of pulmonary ventilation.

The respiratory capacity of a person does not depend on the absolute volume of the throat, but on the extent to which its volume increases between expiration and inspiration. The lung is the slave of the thoracic wall, and follows it in all its movements. It is constantly kept in contact with that wall, through the action of the atmospheric pressure, which is transmitted to the interior of the bronchiæ, whenever the glottis is opened. Except under stress of effort, we can not imagine the lung pushing upon the thoracic wall to dilate it; the contained has to submit to the variations of the containing. Hence, we have no reason to wonder that gymnasts are soon able, by training, to increase their respiratory capacity by giving, through the motions of the upper limbs, a great mobility to the articulations of the thorax, and thus permitting it to dilate more freely under the action of the elevator muscles of the ribs, to the effect of which is added that of the diaphragm. By strengthening the shoulder and fixing the omoplate with strong muscles, we furnish points of support, in raising the ribs and the flattened thorax. The action of the muscles of the abdominal walls counterpoises that of the extensors of the trunk, and the spine is raised by diminishing its curvatures under the effect of these two kinds of curves acting upon it as upon a bow with two curves. Thus, by perfecting the muscular powers and bringing them into equilibrium, the trunk assumes a good attitude, the chest expands, and the man bears the external indications of vigor and health. All these observations are facts demonstrated and known by practitioners, who have obtained them through good gymnastics. They show that there is a direction to be given to exercises having a good result in view, and that the purpose of physical education will be more quickly attained as the methods are more precise. Stirring around in an indeterminate way is certainly not the shortest and most direct means of obtaining the essential modifications sought for.

We have attached so much importance to that part of the hygiene of exercise that bears upon the form, that we have had constructed at the physiological station, with the assistance of M. Otto Lund, an arsenal of instruments of measurement of a new kind. Some of these instruments give the height, weight, and outline in true size of the fore and back curvatures of the spine; others furnish complete sections of the trunk on a horizontal and

on a vertical plane. The measuring-tape gives false indications of the dimensions of the thorax, for its measurements are influenced by the muscular protuberances. We have substituted for gross measurements of the circumference of the thorax those of diameters obtained with compasses and thoracometers specially constructed to give the amplification of the framework of the chest in respiration. With these exact means, and the assistance of physicians who are all interested in these questions, we hope to organize in schools a series of measurements that will cast light on many obscure points. Data are wanting for the definition of the characteristic differences in the form of different subjects whose movements have been accommodated to a special and well-defined profession; and those data in particular are wanting with which to establish the laws of the development of children according as they have or have not been subjected to physical exercise under various conditions. We have begun investigations on this point at the Collége Sainte-Barbe, with the aid of M. Rey, and at the school of Joinville le Pont, with that of M. Roblot. We have found that with growing children the increase of the respiratory capacity is parallel with that of the weight, and has no fixed relation with the stature; and we have shown that the ratio of the respiratory capacity to the weight increases regularly under training. We find also that the absolute dimensions of the thorax do not increase among adults, but that the extent of the movement of the ribs is related to the respiratory capacity. It is, for the same subject, parallel with the quantity of air breathed in. M. Marey showed, some time ago, that the thoracic movements of subjects under exercise are amplified, while their frequency diminishes. Respiration becomes fuller and remains so during rest or after intense exercise. By collating observations bearing on this point, we shall be able to constitute a kind of experimental physiology of exercise, and shall thus have the best and only means of pronouncing without prepossession upon the value, as to the general development of the body, of different methods of education.

We now proceed to examine the tendencies of exercise in view of the economical utilization of muscular strength. The third essential point in physical education consists in establishing the rules that permit the useful and economical employment of muscular force in the various conditions of locomotion, in the management of tools and arms, and in carrying burdens. This is one of the most delicate chapters of animal mechanics. It is the one that is really entitled to be designated the education of the movements, for the educator plays the greatest part in it, and his action is indisputable. When one has devoted himself for a long time to practical exercises of the body, especially to varied exer-

cises, his muscular sense is refined, and he becomes aware of a series of new sensations which remain unknown to those who have never handled tools. In this way we account fairly well for important modifications which are produced in the movements by education.

Absolute muscular force, measured by the dynamometer, soon reaches its maximum, and, if we limit ourselves to this gross measure, we shall have but a false idea of physical perfectionment. It is not, in fact, in the absolute measure of muscular force that a great modification is to be found, but in the aptitude for producing a large sum of work with moderate fatigue and an economical expenditure of force. This refinement is produced in the nervous centers; through attention sustained by the will, through the frequent repetition of well-defined muscular acts, we are able to reach the point of suppressing useless contractions in the desired movement, and bringing into play only a portion of the muscles which were at first contracted in a mass. To this intelligent distribution of the central nervous excitation in the co-operating groups are added a more perfect tact in appositeness, a surer realization of the direction of the intensity and the duration of the contractions, and a greater promptitude in grasping at once all the conditions of the effort. Thus is realized a perfectionment of the motor organs which is manifested externally by address, agility, and sureness of movements, and closely touches upon the higher qualities—confidence in one's strength and courage.

Education should not only be applied to movements of precision, but it ought also to have in view economy in the expenditure of nervous excitation and mechanical labor; it ought to tend to reduce useful contractions to a minimum, and in the end to induce automatism by steadily diminishing the part played by attention, which is absolutely necessary in the beginning. Thus the performing musician is not born a *virtuoso*, he reaches perfection of execution on condition of frequently repeating the same exercises. To acquire perfection of skill, he seeks to obtain equality in the motions of his fingers, ease of hand, arm, and the whole body. He performs the details of a cadence slowly, quickens it progressively, and thus becomes able at last to maintain accuracy in lively movements. Associations of the nervous cells are doubtless produced in his system, which render easy and automatic certain muscular co-operations that were at first insurmountably difficult. The visual perception in the musician comes at last to be translated immediately into a movement of the fingers without any effort of the attention. In the boxer or the swordsman, the slightest manifestation of his adversary's intention produces an instinctive determination which is at once revealed in the attitude.

Normal bearings, like the most complicated movements of gymnastics, are practiced and taught in the same way. There may be an exception in quick movements, such as leaping, which can not be decomposed because they can not be retarded. But skill acquired in difficult exercises creates an aptitude favorable to learning new ones; and it is well known that those who have educated their movements by gymnastics speedily become habituated to the most varied exercises. Yet the skill of a *virtuoso* in any particular art is acquired only by the force of work and patience; and, according to the general law, we are inclined to prize the result of our work according to the quantity of effort it has cost us; in short, to extol the method we have chosen. This is the origin of the schools and of differences in methods, which prevail in gymnastics, as in every other matter—those of Ling, in Sweden; Jahn, in Germany; and Ameros and Triat, in France; and many others who have left various teachings.

Pupils are cultivated by imitation. A group of admirers forms around a chosen person; and among those who seek to imitate him are some who often succeed with great difficulty; the latter are then well disposed to defend their master and their school; they are gratified adepts, who will perpetuate the traditions, with their qualities and their faults. Those minds are rare which can overcome a bad habit when contracted. It is with movements as with moral activity; and that is why every teacher prefers to take his pupils from the beginning, to continuing the labors of his colleagues. It is easily comprehended that the pupil who has contracted the habit of holding his sword in a certain way will find it easier to keep up even a defective attitude, a position that will limit his further progress, than to learn a new one. The effort of attention that he has to make lest he fall back into his false ruts, and to destroy the nascent automatism, is so great that he avoids it. His self-love will not accommodate itself to the idea of becoming a novice, and he prefers going on the wrong way to resuming the toils of first lessons. On these various considerations many practitioners have come really to regard their method as the only good one, and to maintain it, with its errors. But progress in physical education is impossible if we limit ourselves to respect for traditions, to a servile imitation of former things. There can be progress only when we aim at an improvement in attitudes and movements in general. Having been called several times to give our vote in competitive physical exercises, we have been able to observe that the relative merit of the candidates was usually established on conventional bases. Many pupils, who had listened to no other rules than those of nature, and were thus naturally superior, were rated at less than they deserved by judges who were ignorant of these rules. We do not see by what

right we should impose laws on the nature of which we are the resultant. If we would make a durable work, our first thought should be to learn those laws, in order to submit ourselves to them more exactly. We should regard it as an axiom that, given the human organization, there could be only one correct solution in any special case of utilization of force. The problem is to find that solution; and to reach this there is, in my opinion, no shorter way than to study in each sport those select subjects, or experts, who have succeeded by practice in excelling in some specialty. We should for that study arm ourselves with precise means of investigation, which will explain the essential principles of their movements, and take these principles as the rules of education. Although these rules have not yet been established, it is not because experts have been wanting; but the most trained eye can not perceive the subtle differences between the means which experts employ for reaching perfection of movements.

It has been necessary, in order to make a further advance in this study, to create processes which have unveiled a new world of facts. It has been the constant purpose of M. Marey to seek, besides purely subjective sensations, certain experimental data, and thus forestall eternal discussions on obscure points of physiology, in which the fundamental basis itself of discussion—facts—was wanting. The services which the photochronographic method has rendered to biology are well known; in the present case, again, it is invoked as a means of correcting errors. The photographic methods in use at the physiological station give, in short, the complete solution of the analysis of motions, however rapid and complex they may be.

By comparing photographic representations of different subjects or of the same subject at different stages of movement, we may exactly define the manner in which they proceed, seize the slightest differences that distinguish their motions, and perceive the least modifications that are produced in their turn. If these all relate to the same type in the process of perfectionment, we are authorized, after eliminating individual variations, to take and teach what Nature has revealed to us. We can thus study expert subjects under two points of view, for the qualities which they present are derived partly from their structure and partly from their education. Everybody walks, runs, and jumps; but there are few who have a passable gait unless they are trained to it. In short, we learn to walk, run, and jump, as we learn all the rest. We can not well learn alone; and it is one of the essential objects of physical education to perfect the normal gaits as well as all the movements in general. It is furthermore important to extend the individual's life of relation and to accustom it to various movements which are of indisputable utility for defense and for

personal safety. We can learn to swim and climb only by exercises in swimming and climbing. It is not by running that we learn to overcome the vertigo we feel in lofty places or to extricate ourselves from danger by the strength of our arms.

These truths can and ought to be taught. A considerable portion of them are already popular; some, new or less known, form the matter of the new manual of gymnastic exercises and school plays which the Minister of Public Instruction is about to publish.

However important these tentatives in teaching may be, they are still insufficient. There should be instituted in physical education a special technical teaching in which the mechanism of the movements and their physiology shall be studied with all the development which it permits. On this condition we can raise the level and the return of physical education. We can also by this means introduce ameliorations into manual trades by seeking for a more perfect adaptation of tools to the human organization, and in general the best utilization of muscular force wherever it is called into exercise. This branch is, with hygiene, one of the most useful applications of biological science and touches at many points upon the amelioration of the condition of the laboring classes. While it requires the co-operation of a number of particular branches of knowledge necessitating specialization, its social bearing still deserves to interest special minds and exercise the sagacity of students.—*Translated for The Popular Science Monthly from the Revue Scientifique.*

GREETING BY GESTURE.

By GARRICK MALLERY.

I.

VERBAL salutations have generally been employed to explain those expressed by gesture and posture. The study of ancient literature and of modern travel has furnished many friendly phrases of anthropologic and ethnic interest. But friendly greetings were common before articulate speech prevailed. Sign-language was then the mode of communication, and gestures connected with the concepts and emotions of men preceded and influenced all historic ceremonials of greeting. So it is judicious to resort to gesture-speech, as still found surviving among some peoples and deaf-mutes, for the explanation of the existing and still more of the oldest known forms of salutation, whether verbal or silent. Undoubtedly some of the verbal forms are of recent origin and are independent of any gesture,

and such cases require separate discussion; but there are many known instances where greeting is and long has been expressed by gesture without words, and others in which the words used, conjointly or independently, are but derivations from the older, perhaps disused, gestures.

In this application of sign-language the characteristics of that mode of expression appear with distinctness, noticeable among which are the variety of shades of meaning conveyed by substantially the same gesture and the different modes of exhibiting the same substantive concept. Sign-language is more elastic as well as more comprehensive than oral language. Its abbreviation and symbolism are also so clear that linguistic lore and etymologic guess are not needed for their explanation.

The main divisions of the subject to be now considered are—I. Salutations with contact; and, II. Salutations without contact. Under the first division it is convenient to notice successively those directly connected with the sense of—1, touch; 2, smell; 3, taste—although that is not the probable order of their evolution.

TOUCH.—Under the heading of touch come the personal palpations, such as patting, stroking, or rubbing the head, chest, or abdomen. These are very ancient and wide-spread, but have seldom special significance save as expressive of good-will by seeking to give a pleasurable sensation. Licking sensitive parts with the tongue is in the same category; and most actions of this class may be derived from, or at least explained by, those of subhuman animals.

The abdominal surface was most generally favored, its rubbing being practiced in both hemispheres, and ranging from the Arctic Ocean to Polynesia. Perhaps the notorious fact that eating was often continued to painful repletion, after which friction of the abdomen is a relief, may have some connection with the practice; but it is more probable that it arose from the moderate and agreeable warmth and titillation produced by manipulation of that region. The highest mark of respect in the Mariana Islands was to stroke with the hand the abdomen of the person saluted. The stroking of the exposed surface of that part of a friend's body was symbolized in 1823 by the Eskimos stroking down with their palms the front of their own fur jackets.

But other exposed surfaces received the same attention. When the Kaiowa Satana came back to his wives after a long absence, he said not a word, neither did they, but they stroked his face and shoulders gently with indistinct murmurs of endearment. Livingstone reported that the Zambesi patted the hands of the person saluted.

The Gond people pull the ears of their friends. That familiar

performance between the low comedian and the *soubrette* on the stage is probably not immediately connected with the manners of Corea, where, according to H. St. John, "they have no salutations except buffeting each other." The latter may be likened to the proverbial Irish mode of courtship, or with more seriousness to the love-making of lions, where the pat of the paw is subversive.

In many hot regions, markedly in the New Hebrides and New Guinea, actually sprinkling water by the hand over the friend's head is the best expression of friendship. It was symbolized by canoe-men who, on approaching a vessel, sprinkled toward it the sea-water from their paddles, and the significance, if not otherwise known, would be made clear by the spoken words, meaning "May you be cool!" It becomes a question how closely this idea is connected with baptism, and how nearly the old gesture of the hand is preserved in those forms of benediction which are not immediately adopted from the figure of the cross.

In Arabia Petræa the cheeks are pressed together without the use of the lips or hands; and the Indians of Texas in 1685 were noticed to show affection by blowing against the ear. The Biluchi "embrace" by each laying hands alternately on both shoulders of the other. The mutual embrace of affection can not, however, properly be considered as a mere salutation, because it is a communion practiced wholly unconnected with meeting and parting, but it may explain the origin of some of the salutes made with personal contact. Yet certain reports of the occasion and manner of embraces seem to include them among true salutations—e. g., men of the Darling River, when friendly, "salute by standing side by side and casting each of them his nearer arm round his fellow's neck." This suggests the concept of union, though it is more commonly and more conveniently expressed by other actions.

When an Aino returns home after travel, he and his friend put their heads on each other's shoulders; the elder then lays his hand on the younger's head and strokes it down, gradually drawing his hands over the shoulders down the arms and to the tips of the younger's fingers. Until this has been done neither speaks a word. The description would apply to the usual mode of making hypnotic passes. A similar stroking is performed by the Blackfoot Indians of Canada to express gratification.

Other salutes of contact were symbolized by a pantomime in which actual contact was omitted. The Eskimos, as La Potherie told in 1753, "jumped, and rubbed their own stomachs," and the Ainos in informal society stroke their own flowing beards at a visitor, as if to signify, "Consider your beard, if you have any, to be duly stroked."

Some gesture-signs to express friendship are simply symbolic of the actions of friendly greeting. In the remarkable speech of Noaman at Tinicum, on the Delaware River, in the middle of the seventeenth century, he stroked himself three times down his arm, as a greeting of peace, not being able to perform the ceremony to the arms of the auditors. The actions, above mentioned, of the Eskimos in stroking their own bodies and rubbing their own noses, may merely signify that, when they could not get at the proper subjects for nose-rubbing and stroking, they made the semblance of those motions as the sign for their usual physical demonstration of friendship. A case where actual contact and symbolizing appear to be mixed was reported in 1699 by D'Iberville of the Bayogoulas, who first stroked their own faces and breasts, then stroked the breasts of the saluted party, after which they raised their hands aloft, at the same time rubbing them together. The concept of intermingling personalities is indicated. A suggestion of the absorption of happiness through pressure and friction comes from the narrative of Sir John Franklin, as follows: "Whenever Terregannœuck (a Deer-Horn Eskimo) received a present, he placed each article first on his right shoulder, then on his left; and, when he wished to express still higher satisfaction, he rubbed it over his head." This is apparently more than mere taking possession of the article.

Next may be considered the mutual grasp of the hands in greeting. It is difficult to realize that the junction of hands by friends is not instinctive, a physical or sentimental magnetism being so commonly associated with it. Nevertheless, the mutual grasp of hands on friendly meeting, apart from ceremony and symbol, is comparatively recent, and the practice is even yet confined to a limited area. For instance, it appears in Captain Back's Narrative that in 1833 the greeting by union of hands was as strange to the dwellers in arctic lands as their rubbing of noses was to the visitors. Mr. Spencer has published his opinion that the "hand-shake," as the salutation is commonly entitled in English, originated in a struggle, first real, afterward fictitious, in which each of the performers attempted to kiss the hand of the other, which was resisted, thus producing a reciprocating movement. To verify this suggestion it will be necessary to examine into the antiquity and prevalence of the kiss in salutation, which will be considered in its order.

Instances are found for the identical friendly contest for kissing, or priority in kissing, hands, relied on by Mr. Spencer, but they are connected with the topic of precedence as affecting all forms of greeting. Far too much importance is given in the suggested explanation to the shake or motion of the joined hands. The ancient usage, and even that which is now general, is not

"hand-shaking" but hand-taking and pressing. The French expressions are "*serrer la main*" and "*donner une poignée*," or more fully "*échanger une poignée de main*." The translated Gaelic phrase is "Give me the hand," and the German is "*Hand reichen*" or "*Hand geben*." The quotation so often made from Virgil, where Æneas says to his father Anchises, "*Da jungere dextram*," indicates only union. It does not appear that any language but English has the familiar and colloquial form "shake hands" or its equivalent, and this is because the hands are not often shaken among other than English-speaking peoples. No more motion is normally employed than is needed to give emphasis, that is, pressure, to the union, and, except when the gesture is made by awkward persons, the pump-handle is not put into operation. Cases of great excitement, real or simulated, formed exceptions, and the ostensible, perhaps ostentatious, motions derived from such exceptional cases must be classed as extrinsic to the intent and unrelated to the origin of the gesture.

When it is considered necessary to do something obvious in connection with the grasp, as if to proclaim that the act of peace and good-will is performed, peoples not of English origin and not under English influence have devices differing from the "shake." On the Niger the ceremony is completed by the two parties taking loose hold of the fingers of each other's hands and then slipping them, making at the same time a snapping noise with the aid of the thumb. In the same region the Lander party complained of being obliged to "crack fingers" along with other ceremonies. According to Schweinfurth, the Niam-Niam and the Monbutto extended their right hands on meeting, "and joined them in such a way that the two middle fingers cracked." The action is essentially not hand-taking, still less hand-shaking, the object being to join in making a noise by the fingers to emphasize union.

A parallel exhibition of the savage idea that satisfaction should not be silent is in the still extant custom of those Bedouins who pride themselves on their breeding. When they sip coffee they make a noise with their lips such as a horse makes in drinking, which among them is the criterion of the man accustomed to the usages of polite society; he who is in the habit of sipping it noiselessly being regarded as a person whose social education has been neglected. The Zuñi and other Indians, whose sole test of festal enjoyment is in repletion, show their gratification by pronounced and elaborate eructations.

It must be noticed that a mutual struggle for the privilege of kissing the hand could only occur in contention of courtesy between equals. It would be a sign of displeasure for the recognized superior to withdraw his hand from his inferior; and special

favor was shown in the East, not by withdrawal, but by turning the palm to be kissed sometimes instead of, and sometimes in addition to, the back of the hand, which was normally approached by the lips. It is also clear that the hand-taking or grasping, with or without the shaking, was in its essence mutual, which hand-kissing could not be, as the nearest approach to the idea of mutuality in that action would be its exchange in succession. So Mr. Spencer's explanation does not apply to the great majority of the salutes now in question. It is also necessary to bear in mind that the expression "hand-shaking" as reported by English travelers is deceptive, being, as before explained, a mere term. When detailed descriptions are presented it generally appears that there is no "shake," but a mutual grasp or some other use of joined hands. In the present discussion, therefore, the so-called shake may be dismissed as non-essential.

The Chinese saluter clasps his hands together, holds them out, waves them gently, bends forward, and says, "Chin! chin!" meaning, "Please, please!"—or, less definitely, "Thank you," or "Good-by," as the circumstances explain. In the Society Islands the clasping of hands marked the marriage union or the loving compact between two brothers-in-arms, but had no place in ordinary greetings. Among the North American Indians, and in other parts of the world where, as among the Indians, the hand-grasp in simple salutation has not been found, the junction of the hands between two persons is the ceremonial for union and peace, and the sign for the same concept is exhibited by the two hands of one person similarly grasped as an invitation to, or signification of, union and peace. It must be remembered that among the North American Indians to smoke tobacco is the most common salutation. Indians are at peace only with those with whom they smoke, and to smoke is to make peace. When actual smoking is not practicable the gesture-sign for it is also that for "peace" and "friend." The Cheyenne form is—tips of the first two fingers of the right hand placed against or at a right angle to the mouth and suddenly elevated upward and outward to imitate smoke expelled. Apart from this prevailing sign, one, often made for peace, is by clasping the hands in front of the body, the back of the left hand usually down. Some Indians clasp the hands by interlocking the fingers, holding the forearms vertical. The Sac, Fox, and Kickapoo tribes hold before the body the extended left hand, and grasp it with the right. It is of interest, in confirming the above-mentioned concept of these signs, that since the Cherokees have learned to write in their own language by their own syllabary, they place at the end of their friendly missives the word "*wiguyáligû*," meaning, "I grasp your hand at a distance."

The ideogram of clasped hands to indicate peace and friendship is found in pictographs from many localities. It is possible that the exhibition and presentation of the unarmed hand, to be mentioned in another connection, may have affected the practice, but the probability that the paramount idea was that of agreement is enhanced by a prescribed pantomime of the old Roman law continuing down to the empire from the time of Numa, or the prehistoric lawgivers who were embraced in his mythic personality. The contestants before the legal tribunals were compelled each to offer his right hand for the clasp of his adversary in token of good faith and confidence, before the cause was heard. The same pantomime, pretending honesty of purpose, is obligatory now between prize-fighters, stripped and in the ring, before the first blow can be struck. Support to the hypothesis comes also from a formulary which is still common in Ireland and in some parts of England, of depositing saliva in the right hands and then mutually grasping them to solemnize or cement a bargain.

In several parts of the world the junction is not of the hands, but of some or all of the fingers bent so as to form hooks or links, thus removing from the salutation the suggestion of magnetic pressure and sympathy, and substituting that of mechanical attachment. The Papuans of Torres Strait partially bend the fingers of the right hand and hook them with those of the person saluted, then rapidly jerk the hands apart. This is repeated several times. Schweinfurth describes as general in Africa the hooking of the middle fingers, and their violent jerking, often causing the "crack" before mentioned. The Dakota sign for "friend" is to point forward and a little upward with the joined and extended fore and middle fingers of the right hand, which is about a foot in front of the right breast; move the hand upward to the right side of the face, then straight forward about eight inches, and then a little upward. Thus a hook is pictured in the air. Or the bent right index, palm downward, is hooked over the bent left index, palm upward, the hands about a foot in front of the body. The Southern Indians frequently link their index-fingers in front of the body to express friendship. A more emphatic sign made by the Comanche is to bring the two hands near each other in front, and clasp the two index-fingers tightly, so that the tips of the finger and the thumb of each hand touch, thus forming two distinct and united links.

The Delaware Noaman, in his speech at Tinicum, made the sign for friendship in special connection with alliance "by the semblance of making a knot." The etymology of alliance from *alligare*, to bind to, is at once recalled. Some deaf-mutes in the United States interlock the forefingers for "friendship"; clasp the hands, right uppermost, for "marriage"; and make the last sign,

repeated with the left hand uppermost, for "peace." The idea of union or linking is obvious. Other deaf-mutes, to express friendship, link the index-fingers twice, first holding the left hand back down and then turning it back up.

In this connection it is to be noted that the Japanese, in actual salutation, not merely as a sign of it, only indicate the hand-grasp. They fumble with their own hands in greeting, instead of troubling those of the person greeted, which is a proof of their refinement, deserving of imitation in the United States, where the continual and promiscuous hand-taking, which often is hand-shaking, is a serious nuisance, and is properly ridiculed by foreign visitors. The habit, however, is not peculiar to the United States, most Teutonic peoples having the same and being also ridiculed by the French. The Chinese, with a higher conception of politeness, shake their own hands. The account of a recent observer of the meeting of two polite Celestials is: "Each placed the fingers of one hand over the fist of the other, so that the thumbs met, and then, standing a few feet apart, raised his hands gently up and down in front of his breast. For special courtesy, after the foregoing gesture, they place the hand which had been the chief actor in it over the stomach of its owner, not on that part of the interlocutor." The whole proceeding is symbolic, but doubtless is a relic of objective performance. The Chinese symbol for friend, *dok*, is two hands.

Some writers have conjectured that the custom of giving and taking hands is derived from the giving and taking of presents, often an obligatory act of friendship. In several countries objects, perhaps of no value, must always be exchanged on the meeting of friends. To offer, accept, or refuse a hand undoubtedly has import, independent of the manner of junction. Other suggestions have been made to the effect that the hand-grasp was symbolic of the action by which physical help is frequently rendered, as by raising up a comrade who has fallen into a hole. A more poetical concept is clearly indicated in the Oto addition to the common sign for friend: Both hands are brought open before the chest, then extended, and the left hand, with palm up, is grasped crosswise by the right with palm down, and held thus several seconds. The hands are then unclasped, and the right fist is held in the left axilla, by which it is firmly grasped. "One whom I will not let go."

Indians have another mode of expressing "union," "friend," and specifically "brother," and "growing up together." They hold the right hand in front of and back toward the neck, index and second fingers extended, touching, pointing upward and slightly to the front, the others and thumb closed; raise the hand, moving it slightly to the front until tips of fingers are as

high as the top of the head; or the index-fingers of both hands may be used similarly.

A form of expressing friendship accompanied by adoption was reported in 1837 from a Texan tribe. The oldest chief took the white visitor "by the right hand and commenced a sort of manipulation up the arm, grasping it strongly, as if feeling the muscles at short distances quite up to the shoulder." The visitor was obliged to do the same to the chief, and to exchange the same ceremony with all the other chiefs. The Murray-Islanders of Torres Strait do not clasp hands, but each gently scrapes with his fingernails against the palm of the other's hand. These performances remind of certain secret society "grips," and they may have been absolutely on that principle, as many American and some Polynesian tribes have mystic, generally religious, secret societies similar to those of Europe and Asia.

A curious custom of the Ainos may be explained either on the theory of magnetic rubbing or on that of producing union by trituration: A strange Aino is received by the head man of the village visited. Both kneel down, and, laying their hands together, rub them backward and forward. Neither says a word before the ceremony is completed.

SMELL.—The sense of smell, though intimately connected with that of taste, is remarkably acute among the lower tribes of men, therefore probably its exhibition in gesture-speech is at least as ancient as the similar exhibition of the sense of taste.

Smelling and sniffing come early among known salutations, and are still common. Those actions among subhuman animals on their meeting are so well known that comparison is needless. The wants and habits of civilized but not thoroughly cultured life have diminished the functions of smell, and tobacco-smoking, among other usages, has impaired its organs. But relics of the importance once attached to smell are yet found. In Siam there is a rule which might be imitated to advantage. On the approach of an inferior the superior sends one of his attendants to examine whether the visitor has eaten or carries with him anything of an offensive odor. If so, he is refused admission. A remarkable contrast to most of the American Indians regarding scents has lately been reported from British Columbia. Immediately before the expected arrival of friends the tribesmen clean their habitations and bathe, so that no bad odor remains to offend the guests. They also take repeated baths before religious ceremonies, so that their redolence may be agreeable to the Daimon invoked. This concept recalls the still existing Gaelic belief that the fairies are pleased by sweet odors and cleanliness, and are driven off by the opposite. Neither of these examples relates to the use of any cere-

repeated with the left hand uppermost, for "peace." The idea of union or linking is obvious. Other deaf-mutes, to express friendship, link the index-fingers twice, first holding the left hand back down and then turning it back up.

In this connection it is to be noted that the Japanese, in actual salutation, not merely as a sign of it, only indicate the hand-grasp. They fumble with their own hands in greeting, instead of troubling those of the person greeted, which is a proof of their refinement, deserving of imitation in the United States, where the continual and promiscuous hand-taking, which often is hand-shaking, is a serious nuisance, and is properly ridiculed by foreign visitors. The habit, however, is not peculiar to the United States, most Teutonic peoples having the same and being also ridiculed by the French. The Chinese, with a higher conception of politeness, shake their own hands. The account of a recent observer of the meeting of two polite Celestials is: "Each placed the fingers of one hand over the fist of the other, so that the thumbs met, and then, standing a few feet apart, raised his hands gently up and down in front of his breast. For special courtesy, after the foregoing gesture, they place the hand which had been the chief actor in it over the stomach of its owner, not on that part of the interlocutor." The whole proceeding is symbolic, but doubtless is a relic of objective performance. The Chinese symbol for friend, *dok*, is two hands.

Some writers have conjectured that the custom of giving and taking hands is derived from the giving and taking of presents, often an obligatory act of friendship. In several countries objects, perhaps of no value, must always be exchanged on the meeting of friends. To offer, accept, or refuse a hand undoubtedly has import, independent of the manner of junction. Other suggestions have been made to the effect that the hand-grasp was symbolic of the action by which physical help is frequently rendered, as by raising up a comrade who has fallen into a hole. A more poetical concept is clearly indicated in the Oto addition to the common sign for friend: Both hands are brought open before the chest, then extended, and the left hand, with palm up, is grasped crosswise by the right with palm down, and held thus several seconds. The hands are then unclasped, and the right fist is held in the left axilla, by which it is firmly grasped. "One whom I will not let go."

Indians have another mode of expressing "union," "friend," and specifically "brother," and "growing up together." They hold the right hand in front of and back toward the neck, index and second fingers extended, touching, pointing upward and slightly to the front, the others and thumb closed; raise the hand, moving it slightly to the front until tips of fingers are as

high as the top of the head; or the index-fingers of both hands may be used similarly.

A form of expressing friendship accompanied by adoption was reported in 1837 from a Texan tribe. The oldest chief took the white visitor "by the right hand and commenced a sort of manipulation up the arm, grasping it strongly, as if feeling the muscles at short distances quite up to the shoulder." The visitor was obliged to do the same to the chief, and to exchange the same ceremony with all the other chiefs. The Murray-Islanders of Torres Strait do not clasp hands, but each gently scrapes with his fingernails against the palm of the other's hand. These performances remind of certain secret society "grips," and they may have been absolutely on that principle, as many American and some Polynesian tribes have mystic, generally religious, secret societies similar to those of Europe and Asia.

A curious custom of the Ainos may be explained either on the theory of magnetic rubbing or on that of producing union by trituration: A strange Aino is received by the head man of the village visited. Both kneel down, and, laying their hands together, rub them backward and forward. Neither says a word before the ceremony is completed.

SMELL.—The sense of smell, though intimately connected with that of taste, is remarkably acute among the lower tribes of men, therefore probably its exhibition in gesture-speech is at least as ancient as the similar exhibition of the sense of taste.

Smelling and sniffing come early among known salutations, and are still common. Those actions among subhuman animals on their meeting are so well known that comparison is needless. The wants and habits of civilized but not thoroughly cultured life have diminished the functions of smell, and tobacco-smoking, among other usages, has impaired its organs. But relics of the importance once attached to smell are yet found. In Siam there is a rule which might be imitated to advantage. On the approach of an inferior the superior sends one of his attendants to examine whether the visitor has eaten or carries with him anything of an offensive odor. If so, he is refused admission. A remarkable contrast to most of the American Indians regarding scents has lately been reported from British Columbia. Immediately before the expected arrival of friends the tribesmen clean their habitations and bathe, so that no bad odor remains to offend the guests. They also take repeated baths before religious ceremonies, so that their redolence may be agreeable to the Daimon invoked. This concept recalls the still existing Gaelic belief that the fairies are pleased by sweet odors and cleanliness, and are driven off by the opposite. Neither of these examples relates to the use of any cere-

monial perfumes, such as incense, which, indeed, was designed to affect the worshiper.

The junction of noses is so general, and described as so forcible in Africa and Oceanica, as to have given rise to a fanciful theory that it had occasioned the flattening of the noses of the peoples. But in the accounts of many of the tribes of the Dark Continent and of the islanders of New Zealand, Rotouma, Tahiti, Tonga, Hawaii, and other groups, the essential action does not seem to be that of either pressure or rubbing, but of mutual smelling. It is true that the travelers generally call it rubbing, but the motion and pressure are sometimes no greater than that of the muzzles of two dogs making or cementing acquaintance. The pressure and rub are secondary and emphatic. The juncture only means the compliment, "You smell very good!" It is illustrated in the Navigator group when the noses of friends are saluted with a long and hearty rub and the explanatory words "Good! very good; I am happy now!" The Calmucks also go through a suggestive pantomime of greeting in which they creep on their knees to each other and then join noses, as much as possible like the two dogs before mentioned. In the Navigator Islands only equals mutually rub their noses. The inferior rubs his own nose on and smells the superior's hand. The respectful greeting of Fiji is to take and smell the hand of the superior without rubbing it. In the Gambia when the men salute the women they put the woman's hand up to their noses and smell twice at the back of it. In the Friendly Islands noses are joined, adding the ceremony of taking the hand of the person to whom civilities are paid and rubbing it with a degree of force upon the saluter's own nose and mouth. The Mariana-Islanders formerly smelled at the hands of those to whom they wished to tender homage. Captain Beechy describes of the Sandwich-Islanders: "The lips are drawn inward between the teeth, the nostrils are distended, and the lungs are widely inflated; the face is then pushed forward, the noses brought into contact, and the ceremony concludes with a hearty rub."

Sometimes the smelling and the nose-rub are not mutual, being successively exchanged. The Chittagong-Hill people and the Annamites place the nose upon the friend's cheek and inhale through it strongly. They ask not for a kiss, but for a smell. The Khyoungtha of eastern India apply the mouth and nose to the cheek and give a strong inhalation. The Zuñi clasp hands and alternately carry the hand of the friend to the mouth and inhale it. They neither kiss nor smell, but, as they say, "exchange the breath of the life." This action has been erroneously reported as hand-kissing; and several of those above mentioned, which are accurately described as joining the noses and smelling the cheek or hand, have been mistaken for the kiss, either mutual or single.

A tribe of the Eskimos was described by Captain Ross as pulling their own noses for greeting, which he thought had reference to the application of snow as a cure for the frost-bite. It might occasionally have been a signal or warning to a friend that his nose required snow, but as a greeting it was merely symbolic of the rubbing or pressing of noses common both in high and low latitudes. This pressing itself is abbreviated or perhaps indicated in New Guinea by friends simply touching with the hand the tips of their respective noses. The Todas, in respectful address and on approach to sacred places, raise the thumb-edge of the right hand vertically to the nose and forehead. This probably is the gesture of an imprecation—the penalty being that the head may be split open—and has no connection with either smelling or with rubbing the nose, though easily mistaken for those actions. Another symbolic gesture of salutation which is given by the Aino women between themselves may be mentioned. They draw the forefinger of the right hand between the forefinger and thumb of the left, then raise both hands to the forehead, palms up, and then rub the upper lip under the nose with the forefinger of the right hand. This might be translated as expressing admiration for the good odor imputed to the other lady.

TASTE.—After smelling, the gustatory employment of the lips comes in order of time and of culture planes. Regarded merely as a salutation, the kiss seems to have been used between men before it was applied between the sexes—e. g., Cyrus kissed his grandfather in formal reverence "because he wished to honor him." But perhaps this distinction was only because there was no public salutation adopted for men to women, on account of woman's greater seclusion. In the old days the women were regarded as inferiors, and the erect posture required for a mutual and ceremonial kiss in public was subversive of some regulations concerning superior and inferior to be discussed later. The practice of kissing between males, seeming to cultured peoples ludicrous if not disgusting, is still common in continental Europe and in other less civilized regions, but it is seldom performed by the two pairs of lips. The lips of one or successively of both actors are generally applied to the cheek. But sometimes, when kissing the cheek has been reported, the action was in fact misunderstood. In addition to the instances mentioned elsewhere, this error would naturally attend the "blowing upon our ears," as narrated by Joutel of the natives of Louisiana in 1685. Also to-day in Arabia, indeed commonly in the Orient, the lips are applied to the flowing ends of the saluted man's beard. These appendages, to which veneration is always attached, are solemnly raised to the saluter's mouth and kissed. That was the treacherous salutation of Joab to Amasa.

The mutual kiss of affection or passion by the lips between

persons of opposite sex is generally considered to be instinctive. Reichenbach sought to explain it on the theory that the mouth was the focus of his "odic force," and that these two foci of opposite sexes possessed natural attraction to each other. The hypothesis that the kiss is to be derived from the mutual licking of each other by the subhuman animals is unsatisfactory, because those animals seldom bring the soft parts of their respective mouths into contact. They exchange licking as they exchange rubbing of other parts of the body, and such lickings and rubbings are unrelated to sex. But the fact that the mutual kiss between opposite sexes is not general among the tribes of men is abundantly shown by the observations of travelers in the lands where savagery and barbarism still exist. Where it is now practiced it is not probably of great antiquity. In some languages, notably the Japanese, there is no word for kiss.

When, however, the kiss was introduced to include women, its vogue, like that of other new inventions, was carried to excess. According to the chronicle of Winsenius, it was unknown in England until the Princess Rowena, the daughter of King Hengist, of Friesland, instructed the insular Vortigern in the imported salute. Though the Saxon statistics are not probably exact, it is historical that in England, not many generations ago, it would have been the imperative duty of a visitor to have kissed all the ladies of the household, even without previous acquaintance. Such was the experience of many surprised literary foreigners, notably Erasmus. The contemporary drama shows the usage to have lasted into the Georgian era, and it is to be noticed that the performance was generally called a "salute," sometimes "the salute."

The history of the early Christian Church affords instruction on this topic. At first the kiss was an adopted sign of fellowship —"Greet all the brethren with a holy kiss" (1 Thess., v, 26). It early passed into ceremony as the kiss of peace given to a newly baptized convert, and in celebrating the Eucharist. But, as it was found to have some qualities not adapted to religious and spiritual use between the sexes, it was ordered that only men should kiss men and women only women. The awkwardness of this practice, or perhaps the experience that promiscuous kissing, even when limited to the same sex, was liable to convey contagious diseases, induced another amendment, by which the ceremonial kiss in the Roman Church was only passed between the ministrants, and a relic or cross called the *osculatorium* or *pax* was passed to the people for their lips.

It may, perhaps, be suggested that one reason for the very long delay in the practice of the mutual kiss was in the general use by one or both of the sexes of nose-rings or labrets, either of which

would prevent the approximation requisite. If such use be not admitted as a *causa sufficiens,* it at least affords evidence that the kiss was not customary among the people by whom nose-rings and labrets were worn. Indeed, Prof. Dall gives instances where, labrets being common and the kiss unknown, the tongues are protruded in affectionate salutes.

The kiss of the hand is undoubtedly ancient, and therefore is not derived from that of the lips, but probably the converse is true. The hand-kiss is loosely asserted to be developed from servile obeisances in which the earth, the foot, and the garments were kissed, the hand and cheek succeeding in order of time and approach to equality of rank. But it is doubtful if that was the actual order, and it is certain that at the time when hand-kissing began there were less numerous gradations of rank than at a later stage. Kissing of the hands between men is mentioned in the Old Testament, also by Homer, Pliny, and Lucian. The kiss was applied reverentially to sacred objects, such as statues of the gods, as is shown by ancient works of art, and also, among numerous etymologies, by that of the Latin word *adoro;* and it was also metaphorically applied by the inferior or worshiper kissing his own hand and throwing the salute to the superior or statue. In republican Rome kissing the hands of superiors was common, but the greeting was more energetic than the emperors could endure, and soon courtiers of even important station were compelled to kneel and with the right hand carry the hem of the emperor's robe to their lips. Even this became a too precious, or, through proximity, a too dangerous privilege, and they were only allowed to salute at a distance by kissing their own hands, as when they adored the gods. This sign of Rome's decadence has survived in the locality. The mouth kissing the hand, by which Job described a species of idolatry, is a species of adulation practiced by every cringing servant in Italy. When the actual practice has ceased, it survives in phrases. Austrian men habitually say to one another, "*Küss d'Hand!*" and Spaniards "*Beso á Vd. los manos!*" A variant form was found among the Algonkins and Iroquois, as Champlain related, in 1622, that "they kissed each his own hand and then placed it in mine."

Affection, together with respect, is sometimes shown in the Orient when a servant salutes a master, a son his father, or a wife her husband, by kissing the other's hand either on back or palm or both and then carrying it to the kisser's forehead. Among the Malays the visitor approaches the man he wishes to salute with his hands joined as if in supplication, while the other touches them lightly with his own on either side, and afterward raises his hands to his lips or forehead. These motions are similar to the ceremonies in the feudal acts of homage and fealty. The

Micronesians, notably in the Pelew and Caroline Islands, took up either the hand or foot of the party respected and rubbed their own faces with it. Some religious sects—e. g., the Dunkers—also kiss one another's feet—after washing them.

The original concept expressed by the hand-kiss was that of "good." In very early times to possess what had a good taste was of the greatest importance to man, and therefore a good taste was the symbol of any good thing or person. So, when practicable, the hand of the person saluted was carried to the lips to signify that he was good. This act is naturally accompanied by the bowing of the head. The common gesture-sign for "good" in all senses is to carry the hand to and from the lips with a pleasant expression. The spontaneous expression of deaf-mutes is much the same, signifying not only greeting, but satisfaction, in short—good. Their full sign is described as "touch lips with palm or ends of fingers pointing upward, then wave the hands outward to the right and downward, turning palm up." This is a complete description of kissing one's own hand, but it has no relation to the kiss by the pairs of lips.

A common gesture-sign for "peace," the idea of friendship being more directly connected with that of "quiet," is made by placing the forefinger on the lips, which sign has often been erroneously reported as a kiss. Still another Indian sign, similar in motion and in conception, is that which, with variant emphasis and expression, means admiration, or surprise, or a high degree of content. Its essence consists in placing the hand upon or over the mouth, that being sometimes closed and sometimes open, though covered by the hand with rapid emphasis. In the former case it is interpreted to mean that language is inadequate to express the sensations felt. When the mouth is open, with the hand placed over it to attract notice, the sign represents surprise by imitation of the familiar and instinctive action attending that emotion. This sign also has been reported as a kiss of the hand.

Another case where the same error might readily have occurred is also of interest, as showing a contrast with the Zuñi inhalation, giving an equally poetical concept. In equatorial Africa the hands of the person saluted are blown upon, with the words, "Let it be as smooth with you as the breath I blow on your hand."

MR. W. T. WYNDHAM admires the skill with which the aborigines of Australia use stone implements, and turn out work that one would hardly believe possible with such rough tools. They show great ingenuity, particularly in making their harpoon-heads for spearing dugong and fish; instead of shaving the wood up and down as a European workman would do, they turn it round and round, and chip it off across the grain.

PROGRESS IN AGRICULTURAL SCIENCE.

By Dr. MANLY MILES.

THE progress recently made in tracing the interdependent relations of living organisms is clearing up some of the obscure problems in the nutrition of plants that have a direct bearing on the processes of evolution and the applications of science in agriculture.

Since the discovery of the composition of the atmosphere, the problem of the sources of the nitrogen of vegetation has given rise to a wider range of experimental investigation and discussion than any other in vegetable physiology. The evidence appeared to be conclusive as to its source in certain families, including the cereals, while the larger supplies of nitrogen obtained by leguminous plants were not fully accounted for.

The experiments of Boussingault, in France, and the elaborate investigations at Rothamsted, in England, seemed to show that atmospheric nitrogen is not appropriated, to any extent, by the leaves of plants, and that the soil is the main or sole source of the nitrogen of vegetation.

Wheat and barley were the leading cereals under experiment, as field crops, at Rothamsted; and it was found that, while they contained less nitrogen in their composition than leguminous crops, they were specifically benefited by nitrogenous manures. On the other hand, leguminous crops, which obtained larger supplies of nitrogen from the soil, were not benefited by nitrogenous manures, and they grew luxuriantly on soils that did not furnish the cereals with their comparatively limited supplies of nitrogen.

These apparently paradoxical results are now explained, in part at least, by investigations made within the past five years by Hellriegel and Willfarth, Ward, Prazmouski, and others, which have been fully verified by experiments at Rothamsted which are still in progress. Former experiments showed that leguminous plants obtained nitrogen from some source, or under conditions that were not available for the nutrition of the cereals, and it was evidently not obtained from the atmosphere.

It was suggested that the tubercles observed on the roots of leguminous plants had a direct relation to the appropriation of nitrogen; but most observers looked upon them as abnormal and of no physiological significance.

The latest investigations, however, show, beyond the shadow of a doubt, that these "tubercles" or "nodules" are the results of infection by microbes, and that "the relation between the roots and the bacterial organisms is a true symbiotic one, each develop-

ing more vigorously at the expense of the other," and that free nitrogen is appropriated by the microbes.

In 1883 Hellriegel began experiments with leguminous plants in pots of washed quartz sand, to which no nitrogen was added. Marked differences were observed in the growth of the plants under these conditions, but tubercles were found on the roots of the plants that made the best growth, while they were absent in other cases. He was then led to attempt the production of the root-tubercles by seeding or inoculating sterilized sand with a water-extract of a soil in which leguminous plants were growing. To some of the pots, in which peas and vetches were planted, from twenty-five c. c. to fifty c. c. of a water-extract of a fertile soil were added. When this soil-extract was not sterilized, there was a luxuriant growth of the plants in the pots to which it was applied, with abundant formation of root-nodules; but when the soil-extract was sterilized, this result was not obtained.

This soil-extract, however, was without effect on lupines and some other plants; but when the lupine pots were inoculated with an extract of a soil in which lupines were growing, the plants made a luxuriant growth, and root-tubercles were abundantly developed. In all cases the nitrogen supply of the plants was coincident with the development of root-tubercles, that were produced by inoculation with the extract of a fertile soil.

In 1888 a preliminary series of experiments, on the same lines, were begun at Rothamsted by Sir John B. Lawes and Prof. J. H. Gilbert; and in 1889 they were continued, on a more extended scale, with modified conditions suggested by the results of the preceding year. Their first experiments were made with peas, blue lupines, and yellow lupines, in pots seven inches high and about six inches in diameter. For our present purpose we need only call attention to the experiments in 1888 with peas.

Pots 1, 2, and 3 were filled with a washed yellow sand, to which was added 0·5 per cent of the ash of pea plants to furnish the required mineral constituents. Pot 4 was filled with a rich garden soil. Distilled water was used for watering the plants, and no other application was made to pot 1. Care was taken to determine the nitrogen of the soils, and of the seeds planted, which we need not describe in detail.

An extract of a rich garden soil was prepared by shaking in a stoppered bottle one part of soil with five parts of distilled water, and, after the coarser particles had subsided, twenty-five c. c. of the liquid was applied to each of pots 2 and 3. A chemical analysis of this soil-extract showed that the amount of plant food contained in it was so small that it could be safely neglected as an element of plant growth, and that its effect must be attributed solely to the soil microbes it contained.

There was a considerable development of roots in the upper part of pot 1, and a number of root-tubercles were formed, owing to the fact, as proved by subsequent experiments, that the sand was not sterilized before planting the peas. The roots in pots 2 and 3, inoculated with soil-extract, were more abundant than in pot 1, and the root-tubercles were decidedly more numerous and frequently in clusters. The above-ground growth was more luxuriant in pots 2 and 3 than in pot 1, and "in the total vegetable matter there was in pot 2 more than twice, and in pot 3 nearly twice as much, nitrogen as in pot 1 without soil-extract."

A comparison of the total nitrogen in the soil and plants at the close of the experiment with the original nitrogen in the soil and seeds showed that "in pot 1, with the impure and not sterilized sand, but without soil-extract, there was more than three times as much nitrogen in the products as in the soil and seed; in pot 2, with soil-extract, there was about five times as much; and in pot 3, also with soil-extract, there was more than four times as much." There was very little difference in the amount of nitrogen in the soils at the beginning and the close of the experiments, and, neglecting this, it appears that "the nitrogen in the substance grown was, in pot 1, nine and one half-fold; in pot 2, nearly eighteen-fold; and in pot 3, nearly fifteen-fold that supplied in the seed."

In 1889 similar experiments were made with peas, red clover, vetches, blue lupines, yellow lupines, and lucern. For the lupines and lucern glazed earthenware pots, six inches in diameter and fifteen inches deep, were provided, and for the other plants the same pots were used as in 1888.

"The sand used was a rather coarse white quartz sand, from which the coarser and the finer portions were removed by sifting, and more of the finer by washing and decantation, first in well, and afterward in distilled water.

"In each case the sand was mixed with 0·1 per cent of the plant-ash, and 0·1 per cent of calcium carbonate." The prepared sand was sterilized by keeping it for several days at a temperature of nearly 100° C. in a water-bath.

"There were four pots of each description of plant." Of the peas, clover, vetches, and lucern there was one pot of each of the prepared quartz sand without inoculation with soil-extract; two pots of the prepared quartz sand inoculated with the microbes of a garden-soil extract; and one pot of garden soil itself. Of the blue and the yellow lupines there was one pot of each of the prepared, but not inoculated, quartz sand; two pots of the prepared quartz sand inoculated with an extract of a soil from a field where lupines were growing; and one pot of the lupine soil itself, to which was added 0·01 per cent of lupine plant-ash.

"The soil-extracts were in all cases added on July 9th, before

the sowing of the seed; twenty-five c. c. in the case of the peas, the vetches, and clover, and fifty c. c. in that of the lupines and lucern. The seeds, carefully selected and weighed, as in 1888, were sown on July 10th—that is, about four weeks earlier than in the previous year, but still not as early as was desirable."

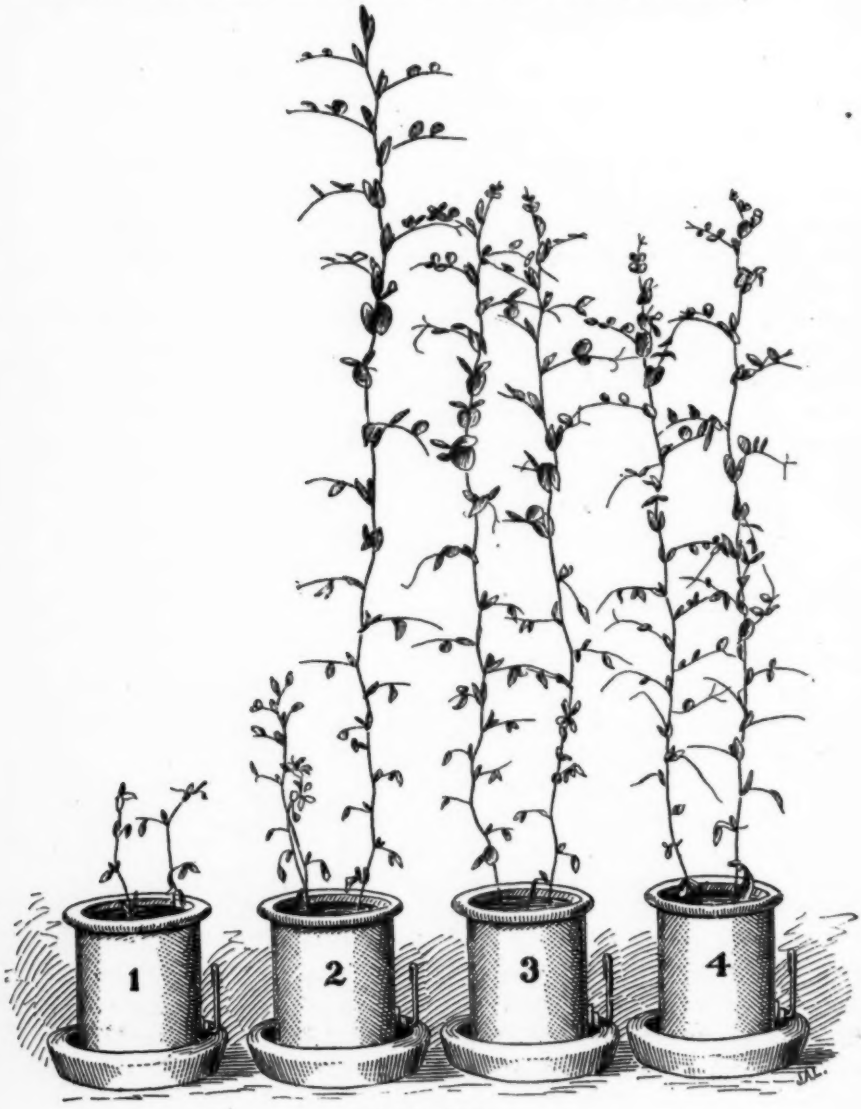

FIG. 1.—PEAS.

Ten seeds of clover, three of the lupines, and two each of the peas, vetches, and lucern, were put in each pot. "No analytical results of the experiments of 1889 are as yet available," and we can only notice the relative growth of the plants under the differ-

ent conditions. The pots of clover and lucern were left for a second year's growth, and their roots could not, therefore, be examined. A photograph of the four pots of peas was made October 22d (a copy of which is given in Fig. 1), and the plants were taken up for examination October 23d and 24th.

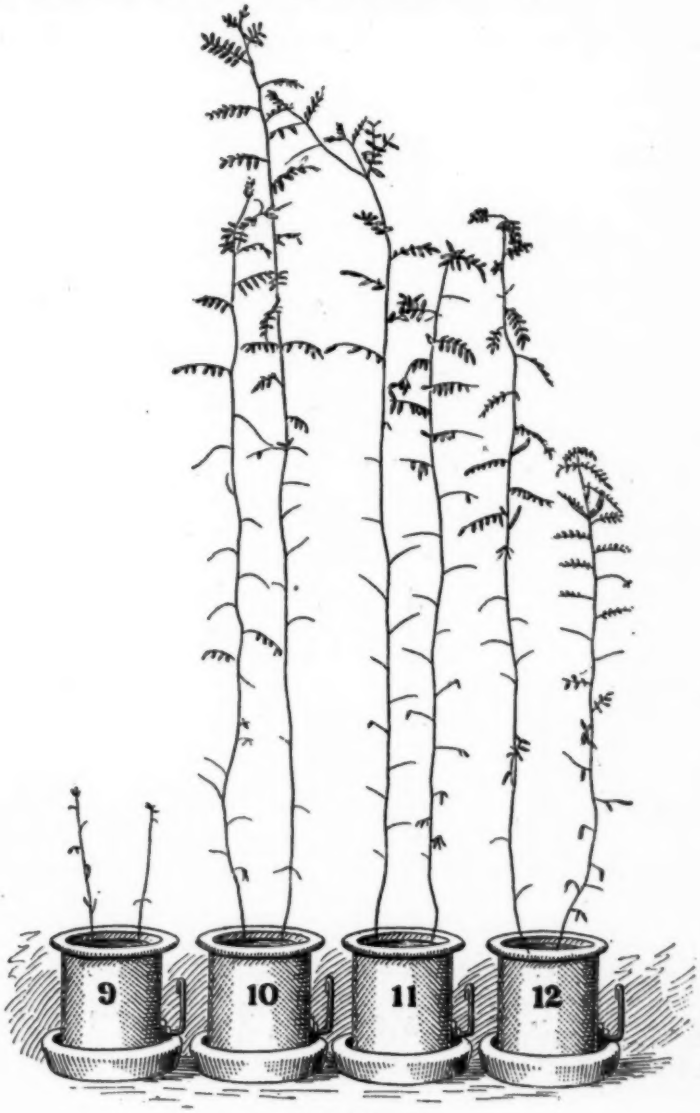

FIG. 2.—VETCHES.

The relative growth and development of the plants in the different pots are clearly shown in the photograph. "Unlike the result obtained in pot 1 in 1888, with the impure and non-sterilized sand, the plants in the purer and sterilized quartz sand (pot 1,

Fig. 1) show extremely limited growth." The plants in pots 2 and 3, inoculated with a soil-extract containing microbes, began to show enhanced growth, when compared with the plants in pot 1, before the end of July. Finally, the plants in pot 1 were eight inches and a quarter, and eight inches and a half high; in pot 2, fourteen, and fifty inches and a half; in pot 3, fifty-two inches and a half, and fifty inches and a half; while in the garden soil, in pot

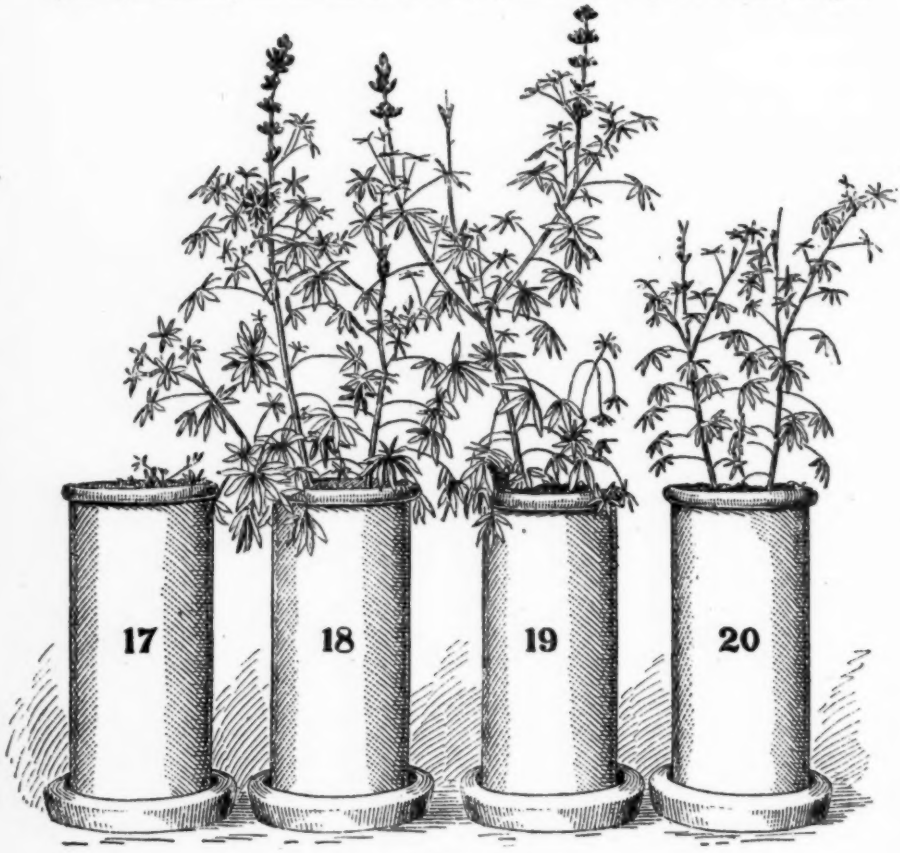

FIG. 3.—YELLOW LUPINES.

4, they made a somewhat less extended growth than those in pots 2 and 3 in a sterile sand inoculated with soil-microbes. It should be remarked, however, that "the plants in pot 4 were more vigorous, and, while they flowered and seeded, neither of those in pots 2 or 3 did so."

A photograph of the vetches was taken October 25th (a copy of which is given in Fig. 2), and they were harvested for examination the following day. The plants in pot 9, which was not inoculated with soil microbes, were eleven inches and a quarter, and ten inches and a half high; those in pot 10, in a sterile but

inoculated quartz sand, were fifty-two inches and a half, and sixty-seven inches high; those in the duplicate pot 11 were sixty-one inches and a half, and fifty-one inches high; while those in pot 12, in a garden soil, were only fifty-three, and thirty-six inches high. As in the case with the peas, the plants in pot 12 flowered and seeded, while those in pots 10 and 11 did not.

Most of the blue lupines, as in 1888, failed to grow. After some reseeding two plants of yellow lupines were grown in each pot. Their relative development, November 29th, is shown in the photograph copied in Fig. 3.

The plants in pot 17, in the sterilized sand not inoculated with soil-microbes, were one inch and a half, and two inches high, "scarcely showing over the rim of the pot"; those in pot 18, in the inoculated quartz sand, measured twenty-four, and eighteen inches, "both spreading much beyond the width of the pot"; in pot 19, also in inoculated quartz sand, one plant was more than two feet and the other but little more than eight inches high; while in pot 20, in a soil from a field where lupines were growing, one plant was but sixteen inches and the other only eighteen inches high, and both less branching than those in pots 18 and 19.

"Unlike the peas and vetches, the yellow lupines, with soil-extract seeding (pots 18 and 19, Fig. 3), flowered and podded freely. One plant in pot 18 had nine small pods, and one in pot 19 four large and three small ones. There were also in pot 20, with lupine soil, on one plant five pods and on the other six. Thus, in the quartz sand with lupine soil-extract seeding, the plants not only produced a great deal more vegetable matter than those in the lupine sand itself, but they as freely flowered and seeded." This was probably owing to the less porosity of the lupine soil when watered in the pot.

The root development and root-tubercles in the different pots may be briefly described as follows: In pots 1 of the peas, 9 of the vetches, and 17 of the lupines, *no root-tubercles could be found*, and the roots were decidedly less developed than in the inoculated pots 2, 3, 10, 11, 18, and 19.

In pot 4 of the peas in the garden soil the roots were abundant, but the root-tubercles were not as numerous as in pots 2 and 3. In pot 12 of the vetches, also with garden soil, the root-tubercles were less numerous, and the roots were not as well developed as in pots 10 and 11. In pot 20 of the yellow lupines, in a soil from a field where lupines were growing, the root-tubercles were not as numerous, and there was less root development than in pots 18 and 19.

In their "preliminary notice" of the results of these experiments, Sir J. B. Lawes and Prof. J. H. Gilbert say: "It will be

admitted that the results so far brought forward are abundantly confirmatory of those obtained by Hellriegel; and that the fact of the fixation of free nitrogen in the growth of *Leguminosæ* under the influence of microbe seeding of the soil and of the resulting nodule formation on the roots may be considered as fully established."

The results obtained by the inoculation of the prepared quartz sand with the microbes of a fertile soil, or of one in which lupines were growing, as shown in the increased growth of the plants in pots 2, 3, 10, 11, 18, and 19, when compared with those in pots 1, 9, and 17, which were not inoculated, are striking; but a comparison of the plants in the inoculated pots with those in pots 4 and 12 in a garden soil, and pot 20 in a "lupine soil," furnish still more significant indications of the futility of purely chemical considerations in discussing the nutritive processes of plants and their relations to the soil. The peas and vetches in a rich garden soil flowered and seeded, but the plants were not as large, and the root-tubercles were not as numerous, as in the sterile quartz sand inoculated with microbes from a fertile soil; and the lupines made a better growth in the inoculated quartz sand than in soil from a lupine field.

The biological factors concerned in the elaboration of plant food seem to be quite as important as the chemical elements provided in the soil itself; and a revision of the accepted theories of plant growth, and the relations of soils to their processes of nutrition, is evidently needed from this standpoint.

It should be remarked, however, that the root-tubercles produced by microbes are not confined to the *Leguminosæ*, as they have, in fact, been observed in several natural orders of plants. Moreover, there are indications that several varieties or species of symbiont microbes are concerned in the production of tubercles on the roots of leguminous plants, and it is probable that each species has its own favored form.

Hellriegel failed to grow lupines in a nitrogen-free soil inoculated with a fertile soil-extract; but, when the inoculation was made with an extract of a sandy soil in which lupines were growing, a luxuriant growth was obtained.

In the Rothamsted experiments on land where red clover had been grown repeatedly, and its yield of nitrogen was reduced to but 22 pounds per acre, vetches, on an average for three years, obtained 120 pounds of nitrogen per acre; lucern yielded as high as 340 pounds, and made an average for six years of 150 pounds of nitrogen per acre; and Bokhara clover yielded crops of 130 and 145 pounds of nitrogen per acre. On land where beans had been grown almost continuously for thirty-two years, and had "practically failed" to grow, their yield of nitrogen per acre hav-

ing been reduced to about 16 pounds on the unmanured plot, and less than 27 pounds on the plot with mineral manure but without nitrogen, very large crops of red clover were grown containing about 300 pounds of nitrogen per acre.

If attention is directed exclusively to the root-tubercles of plants and the roots to which they are attached, it is difficult to understand the manner in which the free nitrogen of the air permeating the soil is made available by the microbes for the nutrition of the more highly organized hosts with which they are associated; but the problem is simplified when we take into consideration the interdependent relations of living organisms arising from their habits, and different requirements in their processes of nutrition.

The influence of cats on the growing of clover seed, as pointed out by Darwin, furnishes a good illustration of dependent relations in the struggle for existence. Cats prey on field-mice that destroy the nests of humble-bees, and the bees are known to be important factors in the fertilization of the clover plant. Quite as marked relations of dependence have been observed among microbes, but the sequence of organisms may be brought about by a different process.

In the ordinary processes of putrefaction we find an orderly succession of living organisms engaged in the work of disintegration in which relations of dependence are clearly manifest. The microbes that initiate the putrefactive process appropriate the materials required for their own growth and multiplication, and the residual mass soon becomes better fitted for the nutrition of other species which succeed them. These are, for similar reasons, succeeded by other forms that are better adapted to the changed conditions, and a series of organisms, of diverse habits, is required to reduce the organic compounds to their elements. Each species performs a specific *rôle*, "the earlier ones preparing the pabulum, or altering the surrounding medium, so as to render it highly favorable to a succeeding form," while their own activities are checked by the changed conditions.

The term *symbiosis*, as now used, is limited to the immediate and direct relations of certain species that are mutually beneficial in their processes of nutrition and growth; but this interdependence of vital activities and interests, in many cases at least, seems to extend to more remote relations through a series of organisms, each of which may have an influence on the well-being of the others. An increased growth of clover in a nitrogen-free soil has been obtained by seeding it with an extract from a root-crop soil; and this, in connection with the facts already presented, is certainly suggestive in explaining the advantages arising from crop rotations.

The micro-organisms that are found in great variety in soils must have an important influence on the processes of metabolism that are constantly taking place in the soil itself; and the results of their activities, which are not limited to processes of putrefaction and nitrification, can not be measured solely by the amount of nutritive materials appropriated. In my own experiments with soil-microbes they have proved their ability to take their required supplies of lime and potash from solid fragments of gypsum and feldspar, and even from the glass tubes in which cultures were made, which were deeply etched by their action.

The roots of plants undoubtedly aid in determining conditions of the soil that favor the vital activities of certain microbes, and interfere with the well-being of others of different habits; and the plants, in their turn, are presumably benefited by the activities of the microbes best adapted to the prescribed conditions. In the struggle for existence the dominance of these favored forms can not, however, be indefinitely maintained. The roots of one species of plant and their associated microbes, in appropriating their required supplies of nutritive materials, induce a metabolism of the soil that, sooner or later, renders it better fitted for other species of plants and other microbe associates; and these, in their turn, prepare the way for species of still different requirements in their processes of nutrition.

Soil metabolism, and the involved liberation or elaboration of plant food, will thus be promoted by a succession of plants of different habits of growth, each with its associated microbes; and the elements of fertility stored in, or permeating the soil, must, under such conditions, be more completely utilized.

It is practically misleading and inaccurate to say that leguminous plants appropriate the free nitrogen of the atmosphere. The evidence clearly shows that the soil-microbes which find favorable conditions for the exercise of their vital activities in the vicinity of, or in contact with, the roots of leguminous plants, are able to make use of the free nitrogen that permeates the soil, and that it is thus made available as combined nitrogen in the nutrition of the higher chlorophyl-bearing leguminous plants. The latest investigations are, therefore, strictly in accordance with the earlier experiments by Boussingault, and at Rothamsted, in showing that the soil is the source of the nitrogen of plants, and we must look to soil conditions as essential factors in determining the vital activities of the microbes that bring free nitrogen into the combined form that is available for the nutrition of the higher plants.

It must be admitted that red clover appropriates nitrogen that has been prepared for it from the free nitrogen of the soil through the agency of its symbiont microbes, but it is well known that it

will not grow for many years in succession on the same land, and other crops must be introduced to put the soil in suitable condition for growing it again. The cereals with their different requirements, through their reactions upon the soil, which are undoubtedly aided by their associated microbes, and even the roots and companion microbes of other leguminous species, may have a direct influence in determining conditions of the soil that favor the nutritive processes of the clover roots and their specific symbiont microbes.

The interdependent biological relations of different farm-crops, and of the soil-microbes that find favorable nutritive conditions in the vicinity of their roots, appear to be quite as important factors in farm economy as the chemical composition of soils and crops, and the conditions of the soil that influence these relations are of great practical interest.

In the light of our present knowledge, it must be obvious that the applications of science to agriculture, so far as crop-growing is concerned, will be best promoted by investigations relating to the life history of these microbes, and their immediate and remote relations to the roots of plants of different species, and to processes of metabolism in the soil under different conditions.

The suggestion made by Dr. M. T. Masters, in his Plant Life on the Farm, that in the future the farmer may be able to apply the ferment-producing germs to his soil, to promote the growth of his crops, with greater advantage than he now derives from the application of chemical manures, seems to be fully warranted by the results of recent experiments; and it may be that the breeding of beneficial microbes may come to be of as great practical interest to the farmer as the breeding of yeast now is in the manufacture of beer.

We must not, however, be misled by the plausible inferences that may be made from the evidence presented in regard to this recently discovered source of nitrogen supply to leguminous plants under special conditions. It is not safe to assume that the nitrogen removed from the soil by crops and by drainage, or otherwise, is fully restored by corresponding amounts derived from free nitrogen through the agency of microbes, or that this is the sole or even the main source of the nitrogen of leguminous crops on average soils.

The Rothamsted experiments show that the previous accumulations of combined nitrogen in the soil must be the source of a large proportion of the nitrogen of leguminous crops, and that the frequent repetition of such crops does not prevent an appreciable diminution of the nitrogen of the surface soil.

The evidence we now have seems to indicate that, under ordinary conditions of farm practice, the microbes concerned in work-

ing up the accumulated stores of combined nitrogen in the soil are quite as significant factors in the nutrition of leguminous plants as their symbiont microbes that appropriate free nitrogen; and the conditions of soils and plants that determine the exercise of these diverse biological activities, in one direction or the other, present a promising field for future investigation. With every advance in knowledge there is increasing evidence that the transformations of matter and energy taking place in the normal processes of living organisms are so exceedingly complex that they can not be expressed or defined in simple formulæ relating to a single department of science, and this fact must be recognized if any real progress is made in solving the problems presented in the applications of science to agriculture.

THE ARYAN QUESTION AND PREHISTORIC MAN.

By Prof. T. H. HUXLEY.

II.

AT the present time, four great separate bodies of water, the Black Sea, the Caspian, the Sea of Aral, and Lake Balkash, occupy the southern end of the vast plains which extend from the Arctic Sea to the highlands of the Balkan Peninsula, of Asia Minor, of Persia, of Afghanistan, and of the high plateaus of central Asia as far as the Altai. They lie for the most part between the parallels of 40° and 50° north, and are separated by wide stretches of barren and salt-laden wastes. The surface of Balkash is five hundred and fourteen feet, that of the Aral one hundred and fifty-eight feet above the Mediterranean; that of the Caspian eighty-five feet below it. The Black Sea is in free communication with the Mediterranean by the Bosporus and the Dardanelles; but the others, in historical times, have been at most temporarily connected with it and with one another, by relatively insignificant channels. This state of things, however, is comparatively modern. At no very distant period, the land of Asia Minor was continuous with that of Europe, across the present site of the Bosporus, forming a barrier several hundred feet high, which dammed up the waters of the Black Sea. A vast extent of eastern Europe and of western central Asia thus became a huge reservoir, the lowest part of the lip of which was probably situated somewhat more than two hundred feet above the sea-level, along the present southern water-shed of the Obi, which flows into the Arctic Ocean. Into this basin the largest rivers of Europe, such as the Danube and the Volga, and what were then great rivers of Asia, the Oxus and Jaxartes, with all the inter-

mediate affluents, poured their waters. In addition, it received the overflow of Lake Balkash, then much larger; and, probably, that of the inland Sea of Mongolia. At that time the level of the Sea of Aral stood at least sixty feet higher than it does at present.* Instead of the separate Black, Caspian, and Aral Seas, there was one vast Ponto-Aralian Mediterranean, which must have been prolonged into arms and fiords along the lower valleys of the Danube, the Volga (in the course of which Caspian shells are now found as far as the Kuma), the Ural, and the other affluent rivers—while it seems to have sent its overflow northward through the present basin of the Obi. At the same time, there is reason to believe that the northern coast of Asia, which everywhere shows signs of recent slow upheaval, was situated far to the south of its present position. The consequences of this state of things have an extremely important bearing on the question under discussion. In the first place, an insular climate must be substituted for the present extremely continental climate of west central Eurasia. That is an important fact in many ways. For example, the present eastern climatal limitations of the beech could not have existed, and if primitive Aryan goes back thus far, the arguments based upon the occurrence of its name in some Aryan languages and not in others lose their force. In the second place, the European and the Asiatic moieties of the great Eurasiatic plains were cut off from one another by the Ponto-Aralian Mediterranean and its prolongations. In the third place, direct access to Asia Minor, to the Caucasus, to the Persian highlands, and to Afghanistan, from the European moiety was completely barred; while the tribes of eastern central Asia were equally shut out from Persia and from India by huge mountain ranges and table-lands. Thus, if the blond long-head race existed so far back as the epoch in which the Ponto-Aralian Mediterranean had its full extension, space for its development, under the most favorable conditions, and free from any serious intrusion of foreign elements from Asia, was presented in northern and eastern Europe.

When the slow erosion of the passage of the Dardanelles drained the Ponto-Aralian waters into the Mediterranean, they must have everywhere fallen as near the level of the latter as the make of the country permitted, remaining, at first, connected by such straits as that of which the traces yet persist between the Black and the Caspian, the Caspian and the Aral Seas respectively. Then, the gradual elevation of the land of northern Siberia, bringing in its train a continental climate, with its dry air and intense summer heats, the loss by evaporation soon exceeded the greatly

* This is proved by the old shore-marks on the hill of Kashkanatao in the midst of the delta of the Oxus. Some authorities put the ancient level very much higher—two hundred feet or more (Keane, Asia, p. 408).

reduced supply of water, and Balkash, Aral, and Caspian gradually shrank to their present dimensions. In the course of this process the broad plains between the separated inland seas, as soon as they were laid bare, threw open easy routes to the Caucasus and to Turkistan, which might well be utilized by the blond long-heads moving eastward through the plains contemporaneously left dry south and east of the Ural chain. The same process of desiccation, however, would render the route from east central Asia westward as easily practicable; and, in the end, the Aryan stock might easily be cut in two, as we now find it to be, by the movement of the Mongoloid brunet broad-heads to the west.

Thus we arrive at what is practically Latham's Sarmatian hypothesis—if the term "Sarmatian" is stretched a little, so as to include the higher parts and a good deal of the northern slopes of Europe between the Ural and the German Ocean; an immense area of country, at least as large as that now included between the Black Sea, the Atlantic, the Baltic, and the Mediterranean.

If we imagine the blond long-head race to have been spread over this area, while the primitive Aryan language was in course of formation, its northwestern and its southeastern tribes will have been fifteen hundred or more miles apart. Thus, there will have been ample scope for linguistic differentiation; and, as adjacent tribes were probably influenced by the same causes, it is reasonable to suppose that, at any given region of the periphery, the process of differentiation, whether brought about by internal or external agencies, will have been analogous. Hence, it is permissible to imagine that, even before primitive Aryan had attained its full development, the course of that development had become somewhat different in different localities; and, in this sense, it may be quite true that one uniform primitive Aryan language never existed. The nascent mode of speech may very early have got a twist, so to speak, toward Lithuanian, Slavonian, Teutonic, or Celtic in the north and west; toward Thracian and Greek in the southwest; toward Armenian in the south; toward Indo-Iranian in the southeast. With the centrifugal movements of the several fractions of the race, these tendencies of peripheral groups would naturally become more and more intensified in proportion to their isolation. No doubt, in the center and in other parts of the periphery of the Aryan region, other dialectic groups made their appearance; but whatever development they may have attained, these have failed to maintain themselves in the battle with the Finno-Tataric tribes, or with the stronger among their own kith and kin.*

Thus I think that the most plausible hypothetical answers

* See the views of J. Schmidt (stated and discussed in Schrader and Jevons, pp. 63–67), with which those here set forth are substantially identical.

which can be given to the two questions which we put at starting are these: There was and is an Aryan race—that is to say, the characteristic modes of speech, termed Aryan, were developed among the blond long-heads alone, however much some of them may have been modified by the importation of non-Aryan elements. As to the "home" of the Aryan race, it was in Europe, and lay chiefly east of the central highlands and west of the Ural. From this region it spread west, along the coasts of the North Sea to our islands, where, probably, it met the brunet long-heads; to France, where it found both these and the brunet short-heads; to Switzerland and south Germany, where it impinged on the brunet short-heads; to Italy, where brunet short-heads seem to have abounded in the north and long-heads in the south; and to the Balkan Peninsula, about the earliest inhabitants of which we know next to nothing. There are two ways to Asia Minor, the one over the Bosporus and the other through the passes of the Caucasus, and the Aryans may well have utilized both. Finally, the southeastern tribes probably spread themselves gradually over west Turkistan, and, after evolving the primitive Indo-Iranian dialect, eventually colonized Persia and Hindostan, where their speech developed into its final forms. On this hypothesis, the notion that the Celts and the Teutons migrated from about Pamir and the Hindoo Koosh is as far from the truth as the supposition that the Indo-Iranians migrated from Scandinavia. It supposes that the blond long-heads, in what may be called their nascent Aryan stage—that is, before their dialects had taken on the full Aryan characteristics—were spread over a wide region which is, conventionally, European; but which, from the point of view of the physical geographer, is rather to be regarded as a continuation of Asia. Moreover, it is quite possible, and even probable, that the blond long-heads may have arrived in Turkistan before their language had reached, or at any rate passed beyond, the stage of primitive Aryan; and that the whole process of differentiation into Indo-Iranian took place during the long ages of their residence in the basin of the Oxus. Thus, the question whether the seat of the primitive Aryans was in Europe, or in Asia, becomes very much a debate about geographical terminology.

The foregoing arguments in favor of Latham's "Sarmatian hypothesis" have been based upon data which lie within the ken of history, or may be surely concluded by reasoning backward from the present state of things. But, thanks to the investigation of the prehistoric archæologists and anthropologists during the last half-century, a vast mass of positive evidence respecting the distribution and the condition of mankind in the long interval between the dawn of history and the commencement of the recent epoch has been brought to light.

During this period, there is evidence that men existed in all those regions of Europe which have yet been properly examined; and such of their bony remains as have been discovered exhibit no less diversity of stature and cranial conformation than at present. There are tall and short men; long-skulled and broad-skulled men; and it is probably safe to conclude that the present contrast of blonds and brunets existed among them when they were in the flesh. Moreover, it has become clear that, everywhere, the oldest of these people were in the so-called neolithic stage of civilization. That is to say, they not merely used stone implements which were chipped into shape, but they also employed tools and weapons brought to an edge by grinding. At first they know little or nothing of the use of metals; they possess domestic animals and cultivated plants, and live in houses of simple construction.

In some parts of Europe little advance seems to have been made, even down to historical times. But in Britain, France, Scandinavia, Germany, western Russia, Switzerland, Austria, the plain of the Po, very probably also in the Balkan Peninsula, culture gradually advanced until a relatively high degree of civilization was attained. The initial impulse in this course of progress appears to have been given by the discovery that metal is a better material for tools and weapons than stone. In the early days of prehistoric archæology, Nilsson showed that, in the interments of the middle age, bronze largely took the place of stone, and that only in the latest was iron substituted for bronze. Thus arose the generalization of the occurrence of a regular succession of stages of culture, which were somewhat unfortunately denominated the "ages" of stone, bronze, and iron. For a long time after this order of succession in the same locality (which, it was sometimes forgotten, has nothing to do with chronological contemporaneity in different localities) was made out, the change from stone to bronze was ascribed to foreign, and, of course, Eastern, influences. There were the ubiquitous Phœnician traders and the immigrant Aryans from the Hindoo Koosh, ready to hand. But further investigation has proved * for various parts of Europe and made it probable for others, that though the old order of succession is correct it is incomplete, and that a copper stage must be interpolated between the neolithic and the bronze stages. Bronze is an artificial product, the formation of which implies a knowledge of copper; and it is certain that copper was, at a very early period, smelted out of the native ores, by the people of central Europe who used it. When they learned that the hardness and toughness of their metal were immensely improved by alloying it with a small quantity of

* "Proved" is perhaps too strong a word. But the evidence set forth by Dr. Much (Die Kupferzeit in Europa, 1886) in favor of a copper stage of culture among the inhabitants of the pile-dwellings is very weighty.

tin, they forsook copper for bronze and gradually attained a wonderful skill in bronze-work. Finally, some of the European people became acquainted with iron, and its superior qualities drove out bronze, as bronze had driven out stone, from use in the manufacture of implements and weapons of the best class. But the process of substitution of copper and bronze for stone was gradual, and, for common purposes, stone remained in use long after the introduction of metals.

The pile-dwellings of Switzerland have yielded an unbroken archæological record of these changes. Those of eastern Switzerland ceased to exist soon after the appearance of metals, but in those of the lakes of Neufchâtel and Bienne the history is continued through the stage of bronze to the beginning of that of iron. And in all this long series of remains, which lay bare the minutest details of the life of the pile-dwellers, from the neolithic to the perfected bronze stage, there is no indication of any disturbance such as must have been caused by foreign invasion; and such as was produced by intruders, shortly after the iron stage was reached. Undoubtedly the constructors of the pile-dwellings must have received foreign influences through the channel of trade, and may have received them by the slow immigration of other races. Their amber, their jade, and their tin show that they had commercial intercourse with somewhat distant regions. The amber, however, takes us no farther than the Baltic; and it is now known that jade is to be had within the boundaries of Europe, while tin lay no farther off than north Italy. An argument in favor of Oriental influence has been based upon the characters of certain of the cultivated plants and domesticated animals. But even that argument does not necessarily take us beyond the limits of southeastern Europe; and it needs reconsideration in view of the changes of physical geography and of climate to which I have drawn attention.

In connection with this question there is another important series of facts to be taken into consideration. When, in the seventeenth century, the Russians advanced beyond the Ural and began to occupy Siberia, they found that the majority of the natives used implements of stone and bone. Only a few possessed tools or weapons of iron, which had reached them by way of commerce; the Ostiaks and the Tatars of Tom, alone, extracted their iron from the ore. It was not until the invaders reached the Lena, in the far East, that they met with skillful smiths among the Jakuts,* who manufactured knives, axes, lances, battle-axes, and leather

* Andree, Die Metalle bei den Naturvölkern (p. 114). It is interesting to note that the Jakuts have always been pastoral nomads, formerly shepherds, now horse-breeders, and that they continue to work their iron in the primitive fashion; as the argument that metallurgic skill implies settled agricultural life not unfrequently makes its appearance.

jerkins studded with iron; and among the Tunguses and Lamuts, who had learned from the Jakuts.

But there is an older chapter of Siberian history which was closed in the seventeenth century, as that of the people of the pile-dwellings of Switzerland had ended when the Romans entered Helvetia. Multitudes of sepulchral tumuli, termed, like those of European Russia, "kurgans," are scattered over the north Asiatic plains, and are especially agglomerated about the upper waters of the Jenisei. Some are modern, while others, extremely ancient, are attributed to a *quasi*-mythical people, the Tschudes. These Tschudish kurgans abound in copper and gold articles of use and luxury, but contain neither bronze nor iron. The Tschudes procured their copper and their gold from the metalliferous rocks of the Ural and the Altai; and their old shafts, adits, and rubbish-heaps led the Russians to the rediscovery of the forgotten stores of wealth. The race to which the Tschudes belonged and the age of the works which testify to their former existence, are alike unknown. But seeing that a rumor of them appears to have reached Herodotus, while, on the other hand, the pile-dwelling civilization of Switzerland may perhaps come down as late as the fifth century B. C., the possibility that a knowledge of the technical value of copper may have traveled from Siberia westward must not be overlooked. If the idea of turning metals to account must needs be Asiatic, it may be north Asiatic just as well as south Asiatic. In the total absence of trustworthy chronological and anthropological data, speculation may run wild.

The oldest civilizations for which we have an, even approximately, accurate chronology are those of the valleys of the Nile and of the Euphrates. Here, culture seems to have attained a degree of perfection at least as high as that of the bronze stage, six thousand years ago. But before the intermediation of Etruscan, Phœnician, and Greek traders, there is no evidence that they exerted any serious influence upon Europe or northern Asia. As to the old civilization of Mesopotamia, what is to be said until something definite is known about the racial characters of its originators, the Accadians? As matters stand, they are just as likely to have been a group of the same race as the Egyptians or the Dravidians as anything else. And, considering that their culture developed in the extreme south of the Euphrates Valley, it is difficult to imagine that its influence could have spread to northern Eurasia except by the Phœnician (and Carian?) intermediation which was undoubtedly operative in comparatively late times.

Are we then to bring down the discovery of the use of copper in Switzerland to, at earliest, 1500 B. C., and to put it down to Phœnician hints? But why copper? At that time the Phœnicians must have been familiar with the use of bronze. And if, on

the other hand, the northern Eurasiatics had got as far as copper, by the help of their own ingenuity, why deny them the capacity to make the further step to bronze? Carry back the borrowing system as far as we may, in the end we must needs come to some man or men from whom the novel idea started, and who after many trials and errors gave it practical shape. And there really is no ground in the nature of things for supposing that such men of practical genius may not have turned up, independently in more races than one.

The capacity of the population of Europe for independent progress while in the copper and early bronze stage—the "palæo-metallic" stage, as it might be called—appears to me to be demonstrated in a remarkable manner by the remains of their architecture. From the crannog to the elaborate pile-dwelling, and from the rudest inclosure to the complex fortification of the terramare, there is an advance which is obviously a native product. So with the sepulchral constructions; the stone cist, with or without a preservative or memorial cairn, grows into the chambered graves lodged in tumuli; into such megalithic edifices as the dromic vaults of Maes How and New Grange; to culminate in the finished masonry of the tombs of Mycenæ, constructed on exactly the same plan. Can any one look at the varied series of forms which lie between the primitive five or six flat stones fitted together into a mere box, and such a building as Maes How, and yet imagine that the latter is the result of foreign tuition? But the men who built Maes How, without metal tools, could certainly have built the so-called "treasure-house" of Mycenæ with them.

If these old men of the sea, the heights of Hindoo-Koosh-Pamir and the plain of Shinar, had been less firmly seated upon the shoulders of anthropologists, I think they would long since have seen that it is at least possible that the early civilization of Europe is of indigenous growth; and that, so far as the evidence at present accumulated goes, the neolithic culture may have attained its full development, copper may have gradually come into use, and bronze may have succeeded copper, without foreign intervention.

So far as I am aware, every raw material employed in Europe up to the palæo-metallic stage is to be found within the limits of Europe; and there is no proof that the old races of domesticated animals and plants could not have been developed within these limits. If any one chose to maintain that the use of bronze in Europe originated among the inhabitants of Etruria and radiated thence along the already established lines of traffic to all parts of Europe, I do not see that his contention could be upset. It would be hard to prove either that the primitive Etruscans could not have discovered the way to manufacture bronze, or that they did not discover it and become a great mercantile people in con-

sequence, before Phœnician commerce had reached the remote shores of the Tyrrhene Sea.

Can it be safely concluded that the palæo-metallic culture which we have been considering was the appanage of any one of the western Eurasiatic races rather than another? Did it arise and develop among the brunet or the blond long-heads or among the brunet short-heads? I do not think there are any means of answering these questions, positively, at present. Schrader has pointed out that the state of culture of the primitive Aryans, deduced from philological data, closely corresponds with that which obtained among the pile-dwellers in the neolithic stage. But the resemblance of the early stages of civilization among the most different and widely separated races of mankind should warn us that archæology is no more a sure guide in questions of race than philology.

With respect to the osteological characters of the people of the Swiss pile-dwellings information is as yet scanty. So far as the present evidence goes, they appear to have comprised both broad-heads and long-heads of moderate stature.* In France, England, and Germany, both long and broad skulls are found in tumuli belonging to the neolithic stage. In some parts of England the long skulls, and in others the broad skulls, accompany the higher stature. In the Scandinavian Peninsula, nine tenths of the neolithic people are decided long-heads; in Denmark there is a much larger proportion of broad-heads.

In view of all the facts known to me (which can not be stated in greater detail in this place), I am disposed to think that the blond long-heads, the brunet long-heads, and the brunet broad-heads have existed on the continent of Europe throughout the Recent period; that only the former two at first inhabited our islands; but that a mixed race of tall broad-heads, like some of the Black-Foresters of the present day, so excellently described by Ecker, migrated from the continent and formed that tall contingent of the population which has been identified (rightly or wrongly) with the Belgæ by Thurnam, and which seems to have subsequently lost itself among the predominant brunet and blond long-heads.

I do not think there is anything to warrant the conclusion that the palæo-metallic culture of Europe took its origin among the

* Prof. Virchow has guardedly expressed the opinion that the oldest inhabitants of the Swiss pile-dwellings were broad-heads, and that later on (commencing before the bronze stage) there was a gradual infusion of long-heads among them. (Zeitschrift für Ethnologie, xvii, 1885.) There is independent evidence of the existence of broad-heads in the Cevennes during the neolithic period, and I should be disposed to think that this opinion may well be correct; but the examination of the evidence on which it is, at present, based does not lead me to feel very confident about it.

blond long-head (or supposed Aryan) race; or that the people of the Swiss pile-dwellings belonged to that race. The long-heads among them may just as likely have been brunets. In north-eastern Italy there is clear evidence of the superposition of at least four stages of culture, in which that of the copper and bronze using terramare people comes second; a stage marked by Etruscan domination occupies the third place; and that is followed by the stage which appertains to the Gauls, with their long swords and other characteristic iron-work. In western Switzerland, on the other hand, at La Téne, and elsewhere, similar relics show that the Gauls followed upon the latest population of the pile-dwellings among whom traces of Etruscan influence (though not of dominion) are to be found. Helbig supposes the terramare people to have been Greco-Latin-speaking Pelasgi, and consequently Aryan. But we can not suppose the people of the pile-dwellings of Switzerland to have been speakers of primitive Greco-Latin (if ever there was such a language). And if the Gauls were the first speakers of Celtic who got into Switzerland, what Aryan language can the people of the pile-dwellings have spoken?*

As I have already mentioned, there is not the least doubt that man existed in northwestern Europe during the Pleistocene or Quaternary epoch. It is not only certain that men were contemporaries of the mammoth, the hairy rhinoceros, the reindeer, the cave bear, and other great carnivora, in England and in France, but a great deal has been ascertained about the modes of life of our predecessors. They were savage hunters, who took advantage of such natural shelters as overhanging rocks and caves, and perhaps built themselves rough wigwams; but who had no domestic animals, and have left no sign that they cultivated plants. In many localities there is evidence that a very considerable interval—the so-called *hiatus*—intervened between the time when the Quaternary or palæolithic men occupied particular caves and river basins and the accumulation of the *débris* left by their neolithic successors. And, in spite of all the warnings against negative evidence afforded by the history of geology, some have very positively asserted that this means a complete break between the Quaternary and the Recent populations—that the Quaternary population followed the retreating ice northward and left behind them a desert which remained unpeopled for ages. Other high authorities, on the contrary, maintain that the races of men who now inhabit Europe may all be traced back to the

* See Dr. Munro's excellent work, The Lake Dwellings of Europe, for La Téne. Readers of Prof. Rhys's recent articles (Scottish Review, 1890) may suggest that the pile-dwelling people spoke the Gaedhelic form of Celtic, and the Gauls the Brythonic form.

great Ice age. When a conflict of opinion of this kind obtains among reasonable and instructed men, it is generally a safe conclusion that the evidence for neither view is worth much. Certainly that is the result of my own cogitations with regard to both the hiatus doctrine (in its extreme form) and its opposite—though I think the latter by much the more likely to turn out right. But I hesitate to adopt it on the evidence which has been obtained up to this time.

No doubt, human bones and skulls of various types have been discovered in close proximity to palæolithic implements and to skeletons of Quaternary quadrupeds; no doubt, if the bones and skulls in question were not human, their contemporaneity would hardly have been questioned. But, since they are human, the demand for further evidence really need not be ascribed to mere conservative prejudice. Because the human biped differs from all other bipeds and quadrupeds, in the tendency to put his dead out of sight in various ways; commonly by burial. It is a habit worthy of all respect in itself, but generative of subtle traps and grievous pitfalls for the unwary investigator of human paleontology. For it may easily happen that the bones of him that "died o' Wednesday" may thus come to lie alongside the bones of animals that were extinct thousands of years before that Wednesday; and yet the interment may have been effected so many thousands of years ago that no outward sign betrays the difference in date. In all investigations of this kind, the most careful and critical study of the circumstances is needful if the results are to be accepted as perfectly trustworthy.

In the case of the remains found in a cave of the valley of the Neander, near Düsseldorf, half a century ago—the characters of which gave rise to a vast amount of discussion at that time and subsequently–the circumstances of the discovery were but vaguely known. The skeleton was met with in a deposit, the loess, which is known to be of Quaternary age; there was no evidence to show how it came there. Consequently, not only was its exact age justly and properly declared to be a matter of doubt; but those who, on scientific or other grounds, were inclined to minimize its importance could put forth plausible speculations about its nature which do not look so well under the light thrown by a more advanced science of anthropology. It could be and it was suggested that the Neanderthal skeleton was that of a strayed idiot; that the characters of the skull were the result of early synostosis or of late gout; and, in fact, any stick was good enough to beat the dog withal.

As some writings of mine on the subject led to my occupation of a prominent position among the belabored dogs of that day, I have taken a mild interest in watching the gradual rehabilitation of

my old friend of the Neanderthal among normal men, which has been going on of late years. It has come to be generally admitted that his remarkable cranium is no more than a strongly marked example of a type which occurs, not only among other prehistoric men, but is met with, sporadically, among the moderns; and that, after all, I was not so wrong as I ought to have been, when I indicated such points of similarity among the skulls found in our river-beds and among the native races of Australia.* However, doubts still clung about the geological age of the various deposits in which skulls of the Neanderthal type were subsequently found; and it was not until the year 1886 that two highly competent observers, Messrs. Fraipont and Lohest, the one an anatomist, the other a geologist, furnished us with evidence such as will bear severe criticism. At the mouth of a cave in the commune of Spy, in the Belgian province of Namur, Messrs. Fraipont and Lohest discovered two skeletons of the Neanderthal type; and the elaborate account of their investigations which they have published appears to me to leave little room for doubt that the men of Spy fabricated the palæolithic implements, and were the contemporaries of the characteristic Quaternary quadrupeds, found with them. The anatomical characters of the skeletons bear out conclusions which are not flattering to the appearance of the owners. They were short of stature but powerfully built, with strong, curiously curved thigh-bones, the lower ends of which are so fashioned that they must have walked with a bend at the knees. Their long, depressed skulls had very strong brow-ridges; their lower jaws, of brutal depth and solidity, sloped away from the teeth downward and backward, in consequence of the absence of that especially characteristic feature of the higher type of man, the chin prominence. Thus these skulls are not only eminently "Neanderthaloid," but they supply the proof that the parts wanting in the original specimen harmonized in lowness of type with the rest.

After a very full discussion of the anatomical characters of these skulls, M. Fraipont says:

> To sum up, we consider ourselves to be in a position to say that, having regard merely to the anatomical structure of the man of Spy, he possessed a greater number of pithecoid characters than any other race of mankind.†

And, after enumerating these, he continues:

> The other and much more numerous characters of the skull, of the trunk, and of the limbs seem to be all human. Between the man of Spy and an existing anthropoid ape there lies an abyss.

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* Evidence as to Man's Place in Nature, 1863, p. 155.

† Fraipont et Lohest, La Race humaine de Néanderthal, ou de Canstatt, en Belgique. Archives de Biologie, 1886.

Now, that is pleasant reading for me, because, in 1863, I committed myself to the assertion that the Neanderthal skull was "the most pithecoid of human crania yet discovered," yet that "in no sense can the Neanderthal bones be regarded as the remains of a human being intermediate between men and apes," * and that "the fossil remains of man hitherto discovered do not seem to me to take us appreciably nearer to that lower pithecoid form, by the modification of which he has, probably, become what he is." †

As the evidence stood seven and twenty years ago, in fact, it would have been imprudent to assume that the Neanderthal skull was anything but a case of sporadic reversion. But, in my anxiety not to overstate my case, I understated it. The Neanderthaloid race is "appreciably nearer," though the approximation is but slight. In the words of M. Fraipont:

> The distance which separates the man of Spy from the modern anthropoid ape is undoubtedly enormous; between the man of Spy and the *Dryopithecus* it is a little less. But we must be permitted to point out that, if the man of the later Quaternary age is the stock whence existing races have sprung, he has traveled a very great way.
>
> From the data now obtained, it is permissible to believe that we shall be able to pursue the ancestral type of men and the anthropoid apes still further, perhaps as far as the Eocene and even beyond.‡

These conclusions hold good, whatever the age of the men of Spy; but they possess a peculiar interest if we admit, as I think on the evidence must be admitted, that these human fossils are of Pleistocene age. For, after all due limitations, they give us some, however dim, insight into the rate of evolution of the human species, and indicate that it has not taken place at a much faster or slower pace than that of other mammalia. And, if that is so, we are warranted in the supposition that the genus *homo*, if not the species which the courtesy or the irony of naturalists has dubbed *sapiens*, was represented in Pliocene, or even in Miocene times. But I do not know by what osteological peculiarities it could be determined whether the Pliocene or Miocene man was sufficiently sapient to speak or not;* and whether, or not, he answered to the

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* Man's Place in Nature, pp. 156, 157.

† Ibid., p. 159.

‡ "Where, then, must we look for primeval man? Was the oldest *Homo sapiens* Pliocene or Miocene, or yet more ancient? In still older strata do the fossilized bones of an ape more anthropoid or a man more pithecoid than any yet known await the researches of some unborn paleontologist?"—(Man's Place in Nature, p. 159.)

*I am perplexed by the importance attached by some to the presence or absence of the so-called "genial" elevations. Does any one suppose that the existence of the genio-hyo-glossus muscle, which plays so large a part in the movements of the tongue, depends on that of these elevations?

definition "rational animal" in any higher sense than a dog or an ape does.

There is no reason to suppose that the genus *homo* was confined to Europe in the Pleistocene age; it is much more probable that this, like other mammalian genera of that period, was spread over a large extent of the surface of the globe. At that time, in fact, the climate of regions nearer the equator must have been far more favorable to the human species; and it is possible that, under such conditions, it may have attained a higher development than in the north. As to where the genus *homo* originated, it is impossible to form even a probable guess. During the Miocene epoch, one region of the present temperate zones would serve as well as another. The elder Agassiz long ago tried to prove that the well-marked areas of geographical distribution of mammals have their special kinds of men; and, though this doctrine can not be made good to the extent which Agassiz maintained, yet the limitation of the Australian type to New Holland, the approximate restriction of the negro type to ultra-Saharal Africa, and the peculiar character of the population of Central and South America, are facts which bear strongly in favor of the conclusion that the causes which have influenced the distribution of mammals in general have powerfully affected that of man.

Let it be supposed that the human remains from the caves of the Neanderthal and of Spy represent the race, or one of the races, of men who inhabited Europe in the Quaternary epoch, can any connection be traced between it and existing races? That is to say, do any of them exhibit characters approximating those of the Spy men or other examples of the Neanderthaloid race? Put in the latter form, I think that the question may be safely answered in the affirmative. Skulls do occasionally approach the Neanderthaloid type, among both the brunet and the blond long-head races. For the former, I pointed out the resemblance, long ago, in some of the Irish river-bed skulls. For the latter, evidence of various kinds may be adduced; but I prefer to cite the authority of one of the most accomplished and cautious of living anthropologists. Prof. Virchow was led, by historical considerations, to think that the Teutonic type, if it still remained pure and undefiled anywhere, should be discoverable among the Frisians, in their ancient island home on the north German coast, remote from the great movement of nations. In their tall stature and blond complexion the Frisians fulfilled expectation, but their skulls differed in some respects from those of the neighboring blond long-heads. The depression, or flattening (accompanied by a slight increase in breadth), which occurs occasionally among the latter, is regular and characteristic among the Frisians; and in other respects, the Frisian skull unmistakably approaches the Neander-

thal and Spy type.* The fact that this resemblance exists is of none the less importance because the proper interpretation of it is not yet clear. It may be taken to be a pretty sure indication of the physiological continuity of the blond long-heads with the Pleistocene Neanderthaloid men. But this continuity may have been brought about in two ways. The blond long-heads may exhibit one of the lines of evolution of the men of the Neanderthaloid type. Or, the Frisians may be the result of the admixture of the blond long-heads with Neanderthaloid men, whose remains have been found at Canstatt and at Gibraltar, as well as at Spy and in the valley of the Neander; and who therefore seem, at one time, to have occupied a considerable area in western Europe. The same alternatives present themselves when Neanderthaloid characters appear in skulls of other races. If these characters belong to a stage in the development of the human species, antecedent to the differentiation of any of the existing races, we may expect to find them in the lowest of these races, all over the world, and in the early stages of all races. I have already referred to the remarkable similarity of the skulls of certain tribes of native Australians to the Neanderthal skull; and I may add that the wide differences in height between the skulls of different tribes of Australians afford a parallel to the differences in altitude between the skulls of the men of Spy and those of the grave-rows of north Germany. Neanderthaloid features are to be met with, not only in ancient long skulls; those of the ancient broad-headed people entombed at Borreby in Denmark have been often noted.

Reckoned by centuries, the remoteness of the Quaternary or Pleistocene age from our own is immense, and it is difficult to form an adequate notion of its duration. Undoubtedly there is an abysmal difference between the Neanderthaloid race and the comely living specimens of the blond long-heads with whom we are familiar, But the abyss of time between the period at which north Europe was first covered with ice, when savages pursued mammoths and scratched their portraits with sharp stones in central France, and the present day, ever widens as we learn more about the events which bridge it. And, if the differences between the Neanderthaloid men and ourselves could be divided into as many parts as that time contains centuries, the progress from part to part would probably be almost imperceptible. — *Nineteenth Century.*

[*Concluded.*]

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* Virchow, Beiträge zur physischen Anthropologie der Deutschen (Abh. der Königlichen Akademie der Wissenschaften zu Berlin, 1876). See particularly p. 238 for the full recognition of the Neanderthaloid characters of Frisian skulls and of the ethnological significance of the similarity.

THE STORAGE OF COLD.

By CHARLES MORRIS.

THERE are two processes constantly active upon the surface of the earth which are of the utmost importance as regards its suitability for human habitation—the storage of heat and the storage of cold. Of these we are here concerned only with the latter. The source and method of the storage of cold (a negative process, which we may here treat as a positive) are much less evident and not so generally known as those of heat-storage, and a review of them may be of interest.

The source of the stored cold is the upper atmosphere, and the principal storing substance snow. Here we are on ground familiar only to scientists. Readers generally are not aware of the vitally important part which snow plays in the economy of nature. The lightly falling snow-flake, with its poetic affiliation and its attractive aspects, has its aspect of terror as well, for the feathery snow has done more to limit man's dominion of the earth than any other of the unfriendly agencies of Nature, even if we count the fiery ravage of the volcano and the ruinous work of the earthquake. While the rains are friends to man, and efficient agents in the progress of civilization, the snows are his enemies, and the most persistently hostile of his foes.

It need scarcely be said that the invigorating beams of the sun visit the earth in very differing measure, varying from tropical profusion to frigid sparseness. This diversity of heat distribution is partly overcome by the agency of the winds and waters, particularly the latter, since the great ocean currents carry vast supplies of heat from the torrid zone toward the poles, and drive far backward the boundaries of the realm of frost. The agency of the air in this heat convection is of less importance. The anti-trade winds move through the upper atmosphere, and lose their heat before descending to the earth; but surface winds from the tropics convey a considerable share of the torrid heats to the colder zones.

Snow is the great opponent to the full effect of this distributed heat. It constitutes an agent of Nature by which the chill of the upper atmosphere is conveyed to the earth's surface, and stored there in a more or less persistent form, which requires much of the solar heat and the warmth of tropic winds and waters to overcome. If it be asked how snow can produce such an effect, we must advert to the heat relations of water. A large supply of insensible heat—latent heat, as it is called—exists in liquid and gaseous matter. In the freezing process this heat becomes sensi-

ble, and is absorbed by the surrounding substances. Such a process takes place on a large scale in the chilled fields of the upper air, the water vapor of the atmosphere being condensed into snow and its latent heat lost to the surrounding frosty air. In a word, snow is water which has lost its latent heat, or—in a negative sense—has absorbed cold from the upper atmosphere. The falling snow conveys this chill to the earth, and thus acts as a great refrigerating agent. To overcome the cold thus conveyed from mid-air to the earth heat is necessary, and large supplies, which might have been usefully employed in the service of man, are lost in the conversion of vapor into snow, and thus indirectly consumed in warming the upper air.

It may be said here that the conversion of vapor into rain is also exhaustive of latent heat. In the evaporation of the oceanic waters a very considerable quantity of heat is absorbed, and conveyed to the upper air as the latent heat of water vapor. Of this heat a part is lost in the formation of rain, and a larger part in the formation of snow. But the rain reaches the earth in a condition suitable for service. It does not, like the snow, need to be changed in its physical state, at a great expense in heat, to render it serviceable. In fact, the chilling influence of rain is inconsiderable, the heat-consuming agency of snow great and important, and the mode in which its work is performed calls for some consideration.

Snow has several curious methods of extending the sphere of its hostile influence. The comparatively light snows which fall in our latitude are of minor importance, since they readily yield to the early spring sunbeams. They are in some degree beneficial to the fertile surface and protective to its more tender annual plants, while their only important adverse effect is the dangerous flooding of the rivers, due to their rapid melting. But the deep and persistent snows of northern regions are far more exhaustive of solar heat, and reduce the agricultural season of those regions to a dangerously short period. In their melting, also, the surface air is chilled, and winds from the north convey this chilled air far to the south, thus spreading widely over the warmer zones the frost-inducing influence of the melting snows.

We have seen how the tropic heats are carried toward the poles by winds and waters. The frigid cold is carried toward the tropics by the same agencies—chilled winds and cold ocean currents. It is carried by another agent of great importance, the direct creep of the snow itself toward the lower latitudes. This agency has once—perhaps many times—produced an extraordinary effect upon the surface of the earth, one far surpassing that of volcanic explosions and lava outflows in its adverse influence. At present this glacial action is greatly reduced, but is still of

much importance. Were it not for the snow-fall the problem of climate would be materially modified, and the temperature of the earth's surface much ameliorated. The seasons would gain a regularity which they do not now possess, the agricultural period of the colder zones be much extended, and the domain of agriculture be considerably widened, by the recovery of broad regions which are now covered during much or all of the agricultural season by snow.

In the winter the frost-laden strata of the atmosphere descend to the surface over much of the globe, and produce a direct refrigerating influence upon the surface soil and waters. This winter freezing, however, is of minor importance, as it, except in the polar regions, quickly yields to the spring suns, while its influence upon the summer temperature of lower latitudes is but slight. Only for the snow-fall this would be our sole source of cold. But the vast blanket of snow which descends annually upon the colder zones conveys downward the severe chill of higher layers of the air, borrowing from a mighty storehouse of cold which broadly impends above the earth. This snow blanket must be removed, and its stored cold overcome by solar heat, before agriculture can begin, and in this process weeks or months pass away, the effect being greatly to reduce the area of the earth's surface which is suitable for human habitation.

The snow of the frigid zones does not wait for the sun to reach it. It travels toward the tropics to meet the sun. This creep of the snow, as we may call it, takes the forms of the glacier and the iceberg. It also acts in another curious method, not generally known, but which is described by Nordenskiöld, in his Voyage of the Vega. Speaking of the natural conditions at a winter station near Bering Strait, he says: "The fall of snow was not great, but, as there was in the course of the winter no thaw of such continuance that the snow was at any time covered with a coherent melted crust, a considerable portion of the snow that fell remained so loose that with the least puff of wind it was whirled backward and forward. . . . Even when the wind was slight and the sky clear, there ran a stream of snow some centimetres in height along the ground in the direction of the wind, and thus principally from northwest to southeast. . . . The quantity of water which in a frozen form is thus removed in this certainly not deep but uninterrupted and rapid current, over the north coast of Siberia to more southerly regions, must be equal to the mass of water in the giant rivers of our globe, and plays a sufficiently great *rôle* among others as a carrier of cold to the most northerly forest regions to receive the attention of meteorologists." It may be that a similar condition prevails over northern America, though concerning this we have no evidence

at hand. The wind thus seems to play a double *rôle* in conveying cold southward—one through the direct carriage of the snow, the other through the aërial chill caused by the melting snow.

The leading agent in the southward creep of the snow, however, is the glacier, and its offspring, the iceberg. The glacier is due to an important relation of the snows to the solar rays; namely, to that in which the stored cold is too great in quantity for the whole year's supply of heat to overcome, so that a part of each year's snow-fall is carried over to the next. There can be no glacier where the whole of the snow-fall is melted, even if the heat of the whole season is occupied in melting it; but, wherever a portion of the snow-supply is carried over from winter to winter, glacial action is inevitable. In every such case the snows must steadily accumulate, their thickness increasing year by year. The growing pressure converts the under portions of this snow mass into ice, and this, through its normal plasticity, is forced by the weight upon it toward lower levels or more southerly regions, until it reaches its limit at that point in which the melting power of the sun balances the growth of the glacier.

The localities of glacial action are, therefore, the peaks and valleys of lofty mountains and the elevated regions of the frigid zones, or the lower regions of the latter in localities of abundant snow-fall. In all such places the heat derived from the sun is insufficient to melt the snow, which, therefore, necessarily creeps to warmer regions in the form of glacial ice. The principal seats of glacier formation in the north frigid zone are Greenland and Alaska. The remaining surface of northern America and that of Siberia are too low in elevation, and perhaps too light in snow-fall, to permit any important glacial effect. Of the northern glacier-forming localities, Greenland is much the most important, and its refrigerating influence upon the coast lands of Europe and America is considerable. The mountains of snow which are heaped upon its elevated regions send down huge glaciers to the coast, which not only aid to chill the waters of the southward-flowing currents, but send south an annual fleet of icebergs, borne upon these cold currents, and making their way far into the Gulf-Stream domain of the Atlantic. No small quantity of the heat-supply of this warm current is exhausted in melting the floating mountains of ice. This heat is lost to the northern continents, and their temperature reduced in consequence, possibly much more than we imagine. There is thus an annual battle between the earth's stores of heat and cold. The former, in the condition of warm ocean currents, makes its way far north. The latter, brought down from mid-air by the snows, and locked up in the glaciers, and their offspring—the icebergs—makes its way far south. They meet in mid-ocean, where an active conflict takes

place. The heat conquers, but at a great loss of its valuable supplies, and a consequent refrigeration of the adjacent waters, air, and land.

In the southern seas this effect of the snow-fall is much more considerable. A belt of glacier-forming lands surrounds the south pole, and the annual iceberg fleet is much larger than that of the north. The air indraught to the north polar region is estimated to extend over a disk of fifty-five hundred miles diameter; that to the south polar region over a disk of seven thousand miles diameter. The former is largely composed of land surface; the latter is nearly all water, and its air is therefore much more charged with moisture. In consequence, the moist air which reaches the south frigid zone is greatly in excess of that which reaches the northern zone of cold, and the snow-fall there must be very much more considerable. It is estimated that the south polar ice-cap can not be less than three miles and may be twelve miles in height. The thrust of this vast ice mountain upon the viscid material beneath it is necessarily enormous, and a lofty ice-cliff is pushed off the land at a rate of not less than a quarter of a mile annually, and this around a circle of great extent. Fortunately, the immense fleet of huge icebergs, thus annually launched, has no continental land to act upon, its refrigerating influence being mainly exercised upon stretches of ocean out of the ordinary channels of navigation, and far removed from the important seats of human habitation.

There was a time, far in the past, but within the era of man's occupancy of the earth, when the influence of the snow was enormously greater than at present, and when the atmospheric chill, stored in the falling flakes, rendered a vast region of the northern continents unfit for human habitation, and extended the border of the frozen zone far toward the present limits of tropical heat. Doubtless if at present all the snow which forms in the upper air should reach the earth's surface, a glacial epoch would now exist in the north temperate zone. The experience of balloonists and of mountain-climbers teaches us that snow forms and falls in all seasons of the year. This is melted by the warmed lower strata of air, and the earth thus saved from its chilling influence. The solar heat, which has already done good work for man upon the surface, performs new and useful labor for him in the atmosphere, by melting this falling snow, so that its water reaches the earth only in the form of rain.

At the period mentioned the snow limit in the atmosphere was much lower than at present, and the great bulk of the snow-fall reached the surface unmelted. As a result, the region of an annual snow surplus extended much farther south than at present, covering much and perhaps all of British America, and a broad

zone of northern Europe. It is not necessary to dwell upon its results. They have already been abundantly told. It will suffice to say, briefly, that the glacial ice thus formed, accumulating until it became of mountain height, crept steadily southward, combating with the sun as it went, until the front of the polar line of battle reached a limit extending across central Pennsylvania, and westward to the Rocky Mountain slope. In Europe it covered many of the active seats of modern civilization. Along this extended line conditions existed resembling those now found along the coast-line of Greenland. At this line the arrows of the sun checked the hosts of the snow, the annual heat balancing the yearly supply of cold, while great streams of chilled water poured from the melting ice. The mountain ranges farther south also sent out their glaciers over wide regions, and a vast extent of the now habitable earth was held prisoner by the snow.

To what extent the remaining regions of the continents were chilled by these vast glaciers can not be easily determined. The cold winds blowing south must have interfered seriously with vegetation over a broad zone. And the oceans of those days must have been crowded with icebergs to an extent far surpassing the commercial fleets of modern times. These may have floated to the tropic seas, and gone far toward exhausting the heat of the torrid zone, and chilling at their source the great ocean currents.

A time at length came when victory perched upon the banners of the sun. Step by step the cohorts of the snow retreated. The earth slowly reappeared from under its crushing weight of ice. Northward went the ice front, as the solar power increased, until it reached the arctic seas, and the northern continents were released from the foe which had so long held them in captivity. But the surface of the continents emerged in a greatly changed aspect. Great masses of rock had been torn by the gliding ice from the mountains, carried far southward, and deposited in a mighty breastwork of rounded and polished stones. The mountains themselves had been scratched and polished by rigid tools of stone, frozen into the ice. Large quantities of gravel and fine mud had been formed by the grinding of the rocks, and carried south by the flowing waters, to be deposited as hills of gravel and beds of clay many miles away from the glacial front. Enormous labor had been done in scooping out the earth's surface into hollows and basins, which became filled with water from the melting ice, and formed the host of lakes, large and small, which now exist over much of the formerly ice-covered region.

Such were some of the permanent effects of this long dominion of the snow, in its secondary form of glacial ice. Undoubtedly the growth of human culture was greatly interfered with by

the long-continued inhospitable condition thus produced, and it is quite possible that, but for the glacial period, the civilization of mankind would have been much further advanced than at present, and most of the awkward questions which are troubling us now would have been settled ages ago. They might, however, have been succeeded by other questions quite as awkward, for the solving of perplexing problems of social relations seems part of the destiny of man. It has been suggested that the glacial age may have aided human advancement, by forcing primitive man to adopt new methods of shelter, clothing, and food-getting, in self-defense against the cold. Thus, instead of hindering it may have helped to break the reign of savagery.

Here it may be well to advert to another probable refrigerating agency of snow to which no attention has hitherto been paid. Aërial snow—snow that forms in the upper strata and is melted at lower levels of the air—may have always been an important agent in the cooling of the earth, aiding essentially in the upward transport of heat during the ages when the surface was at a high temperature. In those ages the great quantity of water vapor in the air hindered the free radiation of heat, whose conveyance upward was mainly accomplished by warm ascending currents. This may have been greatly aided by the conversion of the vapor of these vertical winds into snow in the upper air, the descent of this snow, and the exhaustion of much of the lower heat in melting it.

Such a state of affairs may have extended much further back in time than would at first thought be deemed possible; perhaps to that period when the earth was still too hot to permit the existence of liquid water, and the substance of the present oceans was held in the air as water vapor. Even then the rarer regions of the atmosphere were probably chilled below the temperature of congelation, and a snow limit existed, though very much higher than at present. The range of vapor must also have extended much higher than at present, possibly far within the region of congelation. Therefore, at the period when the surface heat prevented the existence of liquid water, there may have been a continuous formation and fall of snow in the upper strata of the atmosphere. The melting of this snow at lower levels, and the vaporizing, at still lower levels, of the rain which it yielded, must have been highly important agents in the upward transit of the surface heat.

There is thus much reason to believe that the snow-fall, which within the recent period has played so prominent a part in terrestrial affairs, has been from a very early era an active agent in the cooling of the earth, the snow limit of the atmosphere gradually descending through the ages until, in the glacial era, it nearly

approached the surface, and vastly extended the ocean domain by covering a broad region of the land surface with frozen water of almost oceanic depth. With this must have been associated a marked lowering of the level of the oceans, though to what extent it would not be safe to estimate.

COEDUCATION IN SWISS UNIVERSITIES.

By FLORA BRIDGES.

THERE is a sturdy freedom in the Swiss character which is admirable in American eyes, and which seems to make the people grow naturally and easily into conditions closely approaching our own ideals. The soil is not so deep, to be sure, nor so rich, as it might be but for circumstances which the Swiss himself already sees and is taking measures to modify. It is interesting to note the progress of thought in Switzerland in the development of schools. Before the government was thoroughly organized, there were all sorts of schools, loosely, if at all, connected with each other. Each canton, or state, had its own schools, however, thus forming a center of growth whose development may fairly illustrate that in every other state. Let us take Zurich. Here the principal school was one founded and cared for chiefly for the purpose of educating men for the ministry of the Church, in which, however, provision was also made for the study of the classics by those who had chosen some other life-work. This was the beginning of systemization; for this school rested upon those of lower grade, and was itself subordinate to a kind of council made up of its teachers, the leaders of the Church in Zurich, and four other men, churchmen or laymen. These latter were to be elected every year, with privilege of re-election, by a higher Educational Council, two from its own number, the other two at large. This council was composed of the burgomaster, two representatives of state, and twelve other men, eight of whom were appointed by the state Senate.

This condition of schools—there were in addition two for technical training—lasted until 1831, in the spring of which year a new state Constitution was drafted. This gave all authority in school matters to the Educational Council, which it reorganized in the autumn of the same year. It was to consist of fifteen members, appointed by the Senate. Three of these should be chosen from the legislative body of the state, half of the others with reference to their knowledge of and interest in the higher schools, the remainder with reference to the lower schools and practical pedagogics. This new council, under the conviction

that it was desirable to obtain closer connection between the higher schools, at once established two important institutions. The old gymnasium—the Carolinum, as that theologico-classical school had been named after Charlemagne—was enlarged and developed in two directions, scientific and literary on the one hand, and industrial on the other. A still higher school was organized with theological, law, medical, and philosophical departments, which was at first modestly called a *Facultäts-Anstalt*—an institution for higher study. This latter school became in 1833 the University of Zurich, founded by the state "that all her citizens might develop themselves freely, according to nature, in science and art. . . . Its purpose is partly to increase the sum of knowledge, partly to further the interests of Church and state through higher scientific culture of professions." So the university was organized, the canton school by its side as a helper, both under care of the state through the Educational Council, whose president is one of the governor's staff. In similar manner the Polytechnicum—the national school—is under the care of the General Government. The professors in the university are appointed by the Educational Council, and an educational synod, once a year or oftener, if especial need arises, gives opportunity for free discussion.

The Swiss universities are broad and liberal in the highest degree. Statutes are passed in their senates with simple reference to elevation of character and usefulness, and with no apparent thought of the sexes as separate. These statutes, when presented in council, are treated in the same spirit, and the question as to the advisability of coeducation came first in every university after women had already entered and studied. The original statutes excluded no one, and consequently when—after generally a remarkably long time—women applied for admission, their names were taken exactly as those of their brothers were taken; they took their places among these and worked there undisturbed until some other consideration brought the question forward. It is difficult to see why it should have been so long after the establishment of the universities before women asked to work in them. In Zurich it was thirty-one years, in Berne thirty-eight, while Basle was disturbed first last year by the question. Lausanne, however, which begins its career as a university this autumn, begins with women students. In Zurich and Berne it may have been the development of the universities from schools originally founded for the aid of callings as yet unthought of for women which caused the indifference on the part of women toward them. However that may be, when in the sixties women applied for admission in Zurich—the first one was a foreigner—no question was raised; she entered and took her degree. Ten years

later, when so many, chiefly Russians, came with insufficient preparation, a new law was passed regulating the admission of "students" into the university, and formally recognizing women. It had formerly been sufficient for foreigners to present good passports from their Governments; but the new law required in addition testimonials of character and of sufficient previous mental training. If this were not produced, the student must take an examination. This examination, partly oral and partly written, must evidence sufficient knowledge of German to read and to follow a lecturer; sufficient knowledge of mathematics and the sciences to enable the student to understand the university lectures upon these subjects; knowledge either of Latin to read and understand an easy author, or to the same degree of French, with either Italian or English. The Council supported the wisdom of the university senate, and these remain the requirements of the university. Swiss students present diplomas or reports from the Zurich gymnasium or its equivalent; and here girls are somewhat at a disadvantage, for, when the framers of new educational privileges were establishing this canton school which should fit boys for the higher work of the university, they made no such provision for girls. During the early years, while education is compulsory and the state furnishes all books and industrial implements, boys and girls study together; but in the higher schools they are separated, and the courses of study in girls' schools are not so complete as in the gymnasiums for boys. As soon, however, as girls asked for admission to university work, good private schools sprang up, and the normal school was also resorted to. The normal school in Zurich now sends out almost every year, in addition to its well-equipped teachers, at least one or two girls fitted to take the *Maturitäts* examination in either the medical or the philosophical department of the university. At present, moreover, a bill is before the school commission of the state, asking that the canton school be opened to girls, and has, it is thought, fair prospect of being at last adopted.

It was in Berne as in Zurich. Women had studied several years in the university before the question of their admission was ever discussed. The Constitution used only the general term "student," and naturally girls were accepted as soon as they presented themselves. No one could have given any authority or reason for rejecting them. There were five the first year, one of these an American, it is interesting to know, who wished to study medicine. The next year there were twenty-six. The attention of the faculty was arrested: a question arose as to the advisability of simply allowing them to study under the negative provision of the university laws, and a difference of judgment was manifested; but the discussion finally resulted in the passage of a new

resolution in 1874, formally defining the terms of admission for students, and including women. Since then there has been absolutely no question; young men and women work together under exactly the same conditions, and there is perfect harmony, except, perhaps, an occasional unbusiness-like discontent on the part of laboratory students, brought about by their voluntarily extended courtesy toward young women, and the thoughtlessness of these in acceptance of this courtesy. There is only one point of difference in the admission of men and women: men are not asked if they are of age, and if everybody is willing to have them take the university work; girls are.

Basle met the question first, as stated above, a little more than a year ago, one young woman having applied for admission. They were somewhat more conservative in this university, from their long-undisturbed serenity of masculine atmosphere and outlook, and this little rising of woman-ambition touched into life a small cyclone of opposition. The earnest testimony, however, of universities which had tried the experiment allayed the storm, and the young woman bravely entered upon her work and continued through the year. At the close of the year the university acknowledged that all was thus far satisfactory. In every university, we need to remember, the terms of admission, conditions of study, and all requirements, are exactly the same for men and women. It is just as in our own high schools.

For simple admission to candidacy for the degree of Doctor of Medicine, the terms are the same for all, and are determined by the university senate, with consent of the state Educational Council. But if a student wishes to practice in Switzerland, the General Government must prescribe the terms, which it does as follows: The student begins with the *Maturitäts* examination, before alluded to. This makes the following requirements:

A. Languages.

1. Latin. 2. Greek. 3. The mother-language.* 4. A second Swiss national language. 5. The Greek may be replaced by a third Swiss national language, with the same requirements mentioned in section 4.

B. History and Geography.

6. Ancient, mediæval, and modern history, physical and political geography.

C. Mathematics.

7. Algebra. 8. Geometry. Plane trigonometry, and the simplest propositions in spherical.

D. Sciences.

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* German. The "second" and "third" national languages mentioned in 4 and 5 are French and Italian.

9. Natural History. 10. Physics and Chemistry.

Having taken this examination, and studied two *semesters*, the student is admitted to the so-called natural science examination, covering physics, chemistry, botany, and zoölogy, with comparative anatomy. At the end of five *semesters* comes the examination in anatomy and physiology, partly written, partly oral. In this the student must explain some anatomical preparation placed before him, answering questions on anatomy; and must make and explain some histological preparation. He must also prepare a written thesis, within closed doors, upon some physiological subject. The proper oral examination covers anatomy, histology, embryology, and physiology.

Lastly comes the real doctor's examination, which is practical (including written) and oral. The practical embraces—

1. Pathological Anatomy. 2. Pathology and Therapeutics. 3. Surgery and Surgical Anatomy. 4. Obstetrics. 5. Ophthalmology. 6. Medicine and Hygiene.

After all this comes the formal oral examination, covering—

1. General pathology and pathological anatomy. 2. Special pathology and therapeutics, including children's diseases. 3. Surgery. 4. Obstetrics, including women's diseases. 5. Hygiene. 6. Medical jurisprudence. 7. Psychiatry. 8. Theory of medicine.

Such are the examinations required by the Swiss Government of all who practice medicine within its borders; and no thought is given by its universities as to whether the applicant for permission to practice is a man or a woman. The person must only be ready on application, and numbers of girls have justified this confidence. Students of all lands may take the doctor's degree from any department by passing successfully a final examination prepared by the university faculty. All, on the other hand, may be admitted to these other state examinations; and ambitious ones are sometimes found, even among girls, who accept the opportunity.

Up to 1883 the whole number of students who had matriculated in the University of Zurich was about 6,700, of whom 284 were women. One hundred and ninety-one of these women were students of medicine, 91 of philosophy, and two of jurisprudence According to nationality, they may be classified as follows:

	Russia.	Germany.	Austria.	United States.	Switzerland.	Other lands.
Medicine	119	12	7	28	10	15
Philosophy	49	13	7	5	11	6
Jurisprudence	1	..	..	1	..	..

Thirty took the doctor's degree—23 in medicine, 3 in pure philosophy, 4 in science, or philosophy of the second class, as it is called.

Up to the present year, since 1833, the number of male students matriculated is about 7,300 in round numbers, of whom 988 —more than one eighth—have taken their degree. Since 1864, the year when women entered the university, the number of women matriculated is 484, of whom 57—more than one ninth—have taken their degree. The women graduates are classified—

	Russia.	Germany.	Austria.	United States.	Switzerland.	Other lands.
Medicine	9	5	4	6	6	5
Philosophy I	1	2	3	4	1	1
Philosophy II	7	1	..	2	..	..
Jurisprudence	..	..	..	..	1	..

From the establishment of the university up to the present date, the whole body of graduates may be thus classified:

	Jurisprudence.		Medicine.		Philosophy I.		Philosophy II.	
	Men.	Women.	Men.	Women.	Men.	Women.	Men.	Women.
1833–1864	30	..	182	..	16	..	21	..
1864–1890	79	1	249	35	101	12	310	9

In addition to the examinations taken, each graduate prepares a thesis upon an assigned subject, and these publications are of no small worth. A study of the subjects convinces one that in this way the results of a vast amount of original investigation in science, literature, and philosophy have become common property. And there are also many other publications, not only from graduates, published after the final theses, but also from those who have taken partial courses—publications of considerable interest and importance. It is impossible to follow these young women through their after-lives and describe their various services to humanity. The one jurist, Mrs. Kempin, of Zurich, is perhaps the only woman in America now giving lectures in a college for woman students of law. Miss Helene Webster, a graduate of 1889, now holds the chair of Philology in Wellesley College. And so one might name others. But, from an investigation of their university life, one can judge whether the enlarged vision supposed to result from higher education probably followed in their cases, and whether the privileges were wisely bestowed.

In the first place, knowledge that the university doors stand open leads to the formation of earnest purpose and to a wise disposal of hours and energies in the early years of life, while character is forming a good foundation. The work of these young women in Zurich, after admission to the university, proves this. Professors testify that their conscientious fidelity to tasks imposed and their earnestness manifest an influence not only on the char-

acter of the final theses, but also upon the general standard of scholarship in the university, because the whole body of students becomes more industrious; and following this naturally the standard of the lecturers must be correspondingly raised. It is claimed that the requirements in examinations are rather higher in Swiss universities than in those where women are not admitted to equal privileges. The students themselves grant that the influence is good by their cheerful acceptance of the conditions and their business-like adjustment of each other's rights—men and women together as men and men together, according to rules of refined courtesy. A tutor from the University of Vienna visited Zurich during the past winter for the purpose of observation, because an appeal had come from women in Vienna for admission to study. He was much impressed by the air of order and business which the class-rooms everywhere presented. The live interest which pervaded everything and absorbed all thought of self or sex in delight of new power to see and do, was incomprehensible to him. Such earnest preparation and such sensible recognition of favorable conditions and devotion to a chosen work must make women who will be powerful afterward in the general work of elevating humanity; and when all the world's universities thus join hands in developing all the forces God has placed latent in men and women, the full light will sooner shine into corners which are as yet mysterious and only tempting to man's curiosity or tantalizing to his needs.

CHINESE BUDDHISM.

By WARREN G. BENTON.

IN a former paper, on the Taouist Religion, it was the purpose of the writer not to dwell upon the strictly historical features of the subject. That has been done by others, whose conclusions are recorded in books and encyclopædias which may be consulted. But the object aimed at was to give as true a picture as possible, in small space, of the practical workings of the system at the present time.

In writing of Chinese Buddhism the purpose is not to enter the historical phases of the question, but to show the present status of this ancient faith in the land of its adoption.

Historians generally agree that the religion was invented in Hindostan, about six centuries B. C., and that it has spread throughout almost all of Asia, until it is to-day the religion of at least a third of the human race. To have lived so long, and reached so wide a field in its conquests, indicate elements of vitality not frequently matched in the world's history; and, while its

origin, as well as its founder, is so far back, as the annals of history go, as to be shrouded in mystery, and even by many attributed to mythology, yet that it still lives and thrives as the most widely accepted religion none can deny. A reason for this fact must be sought in other directions than the perversity and ignorance of human minds, which incline men to accept absurd beliefs as a substitute for truth, as many assert.

There must be somewhat in a system of religion or philosophy which accords with human experience, and which tends to better the condition of life, and to foster hope, in order that a decade of centuries may pass without witnessing any diminution of its power. It is not sufficient to assume that its being a system of ingeniously woven myths is sufficient to account for its ready acceptance by unintelligent and unscientific Oriental minds. For even New York and London, as well as other centers of intelligence in our own civilization, have their rapidly growing theosophical societies, whose members include men of intelligence. These have formulated, according to their own fancies largely, what they are pleased to call a Buddhist creed; and, while they do not build temples, and ornament them with wooden images of their patron saint, as do their Oriental brethren, yet they none the less ardently declare their belief in the cardinal teachings of the system.

There is a tradition among Chinese scholars that, not far from the beginning of the Christian era, a rumor reached China that a great reformation was going on to the westward, and the emperor sent a committee to investigate the matter and report. The committee went overland through Burmah into India, inquiring at each stage of their journey as to the reports. In this way they encountered the promulgators of the Buddhist faith, who, on learning the object of their visit, informed them that their journey was at an end, and that they had found the true religion. On investigating the subject, the committee returned and made a favorable report; whereupon the emperor announced that the religion of Buddha was good for the people, and adopted it officially as one of the state religions of the empire. From that time the Buddhist missionaries found China a "field already white for the harvest," and it was at once recognized as the chief religion of the people, and has continued such ever since. Some scholars in China believe that it was the founding of Christianity that had reached their country; and that, had the committee continued their journey farther, China would have been among the first nations to adopt the Christian religion, instead of, most probably, the last people now likely to adopt it as a nation. The idea opens the way to much speculative fancy, but it lies outside the purpose of this paper to pursue it.

The first thing to attract the attention of one investigating Chinese Buddhism is the many points of similarity in the details with the Roman Catholic system. So striking was this resemblance, that the first Catholic missionaries declared that, in some manner, their own faith had preceded them; and that the Buddhism of the twelfth century was really copied from, or a perversion of, the Roman faith. But, finding that dates did not justify this solution of the matter, they then asserted that the devil, in anticipation of the true religion, had planted a counterfeit (older than the original), for the express purpose of preventing the people from accepting salvation when it was offered to them. This is hardly made clear enough to meet the inquisitive mind in seeking a solution of the matter.

While in China, investigating this subject of the "Religions of the Orient," I visited many Buddhist temples, conversed through interpreters with many priests and laymen on the subject, and put up at temples for weeks at a time, studying the methods observed in the semi-daily worship or performances; and reached certain conclusions which may have some interest to others. And in what I shall say it shall be my endeavor to treat of the present status of the ancient faith as exemplified in the present generation of believers, leaving the reader to form his own conclusions. I am not an advocate for or against the system, and shall seek to view it impartially.

In the first place, the present generation of Buddhists give but little or no thought to the origin or founder of the faith. There is apparently none of the controversial element in them. They ask no questions and have no doubts. That Buddhism exists, and meets all their requirements in the religious line, they know; and with that they are content. All efforts to dislodge this ancient faith are met with the most aggravating indifference; and such as have nominally adopted the Christian system have apparently not abandoned the old, but simply taken on another additional string to their bow. With most men, one religion is sufficient, but not so with pagan John. In this respect, indeed, the "heathen Chinee is peculiar." The same individuals believe in and practice no less than four different systems of religion. Taouists are also Buddhists, and Confucian disciples recognize both systems; while all together, and even the Mohammedans—of whom there are many in China—recognize the state religion, of which the emperor is the representative and custodian. And it is said that many Roman and Protestant converts also adhere to their former belief in the native articles of faith.

Buddhist priests are not, as a class, educated in any legitimate sense. They mostly are able to repeat from memory the ritual of the faith, and many include in their mental storehouses a literal

memorized text from the "classics"; but in matters of general interest they are often the merest children in knowledge. They are recruited from all classes of society, but most generally from the so-called literary class. They are strictly celibates, and are vegetarians in living. Priests are exempt from the law which requires every other male Chinaman to wear the crown-locks braided in a queue, while the rest of the head is smoothly shaved.

Formerly the custom of scalp-taking in the event of conquest was observed by the Tartars and Chinese (from whom the custom was handed down through their successors in this country, he Indians); but when the Tartars subjugated China they issued a decree that all who would shave their scalps, except the scalp-locks, in token of subjection, and wear that in a braided queue, to be ready to be removed if emergency should arise, would have their lives spared. It is not recorded how many refused to accept the conditions, but the queue on the head of every Chinaman to-day is the flag of truce, as it were, and by it he is counted loyal to his conquerors; but the priests were exempted from this rule, owing, no doubt, to the custom already in vogue among them of shaving the head clean as a mark of humility.

The priests live in the temples, having no other home. The temples are located in the most inaccessible places in mountains and on islands, and often cover acres of land. They are void of architectural beauty or effect, and consist of a main auditorium, with a succession of sheds attached, windowless and plain. The main room is furnished with an altar, on which is placed an image, generally of wood, of Buddha, sitting upon an imitation lotus leaf, and on either side of this image are other images of lesser lights in the calendar of saints who are supposed to be especially celebrated in Buddhist annals. In front of these figures incense-sticks burn day and night. These are made of dried aromatic wood reduced to fine powder and mixed into paste with oil and then put on splinters of dry wood, the lower end of which is stuck into a vase of sand and the upper end lighted, which burns slowly without a blaze, the curling, slender volume of smoke shedding forth an odor which counteracts the damp, musty smells of the old stone walls and sunless rooms.

The sheds attached serve as living-rooms for the priests and as guest-chambers for pilgrims and travelers.

At intervals around the walls of the audience-room stand the images of other saints in the calendar, which includes eighteen or more principal characters. These are not intended to represent deities, as many people suppose, but simply symbolize and preserve the memories of the men who figured prominently in the past history of the religion. They are supposed to represent

also certain ideas connected with the conception of certain attributes, such as Love, Mercy, Justice, War, etc., and each figure has been made to convey the idea of his specialty.

For example, the Love symbol is shown as a fat, jolly-tempered man surrounded with little children at play. Justice sits with a face utterly devoid of all traces of sympathy, and with eyelids drawn down and lips firmly closed, and, with drawn sword, symbolizes the fate of the evil-doer. Thus, each figure is intended to impress the observer with a proper observance of the graces inculcated in the religion. But they are not worshiped. Nor has Buddha been deified in any proper sense, but is looked upon as the founder and best example of the faith. So far as I can judge, no prayers are offered to him as such, but, while he occupies the post of honor in all temples, he is merely venerated as above indicated.

Morning and evening services are observed in the temples, which consist of a certain number of strokes upon a great bell and a similar number of taps on a huge drum, which sometimes consists of a section of a hollow trunk of a tree, with rawhide fastened across one end; and this noisy demonstration is preceded and followed by repetition of ritual, and bowing and kneeling in turn in front of the central altar. Nothing can be more weird than to listen to the beating on the drum and bell in the stillness of a mountain gorge at sunset, where no sound except the occasional howling of tigers near by comes to break the monotony of the mountain stillness. I can well understand how it affects the minds of ignorant worshipers, inspiring in them an awe equal to that produced by the most profound ceremonies of the churches on the minds of the worshipers.

They have no set days for the people to come to the temples to worship. The priests keep up the service above named at sunrise and sunset of each day, and the laity may come to the temples at any time they see fit. Prayers are said for the people, or rather by the people, in a sort of lottery scheme. A joint of bamboo, open at one end, is kept in the temples, in which are an assortment of prayers and omens good and bad. The worshiper (?) selects one of these by chance, much as we sometimes see children pulling straws for the longest or shortest to decide some question in dispute. If the first effort gets an undesirable "prayer," it is put back and another drawn. This is repeated until the worshiper gets one that suits him, and then he goes on his way, feeling sure that the blessings of Heaven will rest upon his undertakings.

There are monasteries and convents in addition to the temples, and these are carried on for the same purposes and very similar in all respects as the Roman institutions of the same nature.

Among the tenets of the faith is one commonly called "works of merit," similar to and for the same objects as supererogation —that is, doing more good than the present emergencies require— for the purpose of having a balance to one's credit in case of emergency. Priests under such pious inspiration go into the markets and buy squirming eels of fish-mongers and liberate them. Paying for them with money first begged from door to door. The relative merits of buying these eels and giving them to the hungry for food have not occurred to them; but they are not the only people who take the least probable route to gain favor in the sight of their final Judge. Acts of personal torture and self-denial rank high in the line of "merit," and men are not infrequently met with who inflict the most atrocious penalties upon themselves in the vain belief that it will gain them high standing in the eyes of the powers that control their future destinies. The people can not understand disinterested benevolence; hence, when missionaries go among them and apparently put themselves to inconveniences to induce the people to accept their teachings, they are looked upon with a certain respect; but their actions are invariably construed as being "works of merit," and that, instead of their good, it is the future good of the missionary himself which he is looking after.

I knew an English missionary who went into the famine district, twelve years ago, to distribute the relief sent there from England; and the chances were ten to one that he would never return alive. Yet the people admired him as being piously seeking to lay up treasures in heaven to his own credit.

But the leading characteristic of the Buddhist faith, and the one in the light of which all their actions and observances must be judged, is the doctrine of transmigration of souls. In this belief lies whatever of practical good comes from the system, in addition to the rest of mind and contentment which come of one being entirely satisfied with his faith. It is urged by religious people in this country that the disciplinary benefits arising out of the belief in a future state of rewards and punishments are apparent in and essential to good society; that if a belief in this doctrine be annihilated, society would lapse into a state of barbarism and outlawry. Without entering into any discussion of this question, it is sufficient to say that the restraining effects of the belief in transmigration are an equally strong motive for right-doing.

They believe that life is a succession of existences, and that every grade and condition of life are the product of a former career. All animals are equally immortal as men; and, in fact, the souls of all are identical and interchangeable. Hence, to kill an ox or a dog is as much murder as to kill a man. So strong is this belief,

that no Buddhist will take the life of an animal for food, the pig and fowls alone excepted. But for the contingent of Mohammedans in Chinese cities, Europeans would fare badly for beefsteaks and lamb-chops. I never knew a Chinese butcher who was not a Mohammedan; and when Mohammedan butchers buy fatted cattle of pious Buddhist farmers, they have to promise that the cattle shall not be slaughtered. I once asked a fish-dealer why he made a distinction in his line. He said that he never killed fish, but that when taken out of the water they died. I suggested that if he were to reverse this rule and put an ox under water, he too would die without being killed. When, however, the soul of an animal has departed, the carcass is exempt, and finds ready takers among the faithful who are not averse to eating beef. It is from this fact that all animals having died natural deaths are used by the people as food. The only exception to this rule of eating dead animals is in the case of their having belonged to a priest. I once shot a priest's dog, and it was buried with great ceremony (at my expense), and, when asked why they did not eat it, was told that being a priest's dog it was sacred. That made, of course, a great difference!

The beneficial results from this belief are apparent in the kindness to all domestic animals. No need for Mr. Bergh's society there. When a farmer harnesses his faithful ox or cow to plow his field, he treats the beast with the utmost consideration, for the reason that, for aught he knows, he has harnessed the soul of his own grandfather; and that the soul of the beast is watching him, and knows just what he is doing, he does not question.

Buddhists accept the proposition that one's relative rank, whether as a poor man, or, next thing to that, a pig or a donkey, is entirely due to his actions in a former life. And no matter how humble one's lot may be, he devoutly hopes for promotion in the next *inning*. One of the most potent fears in the minds of many men is that they may be born next time as a donkey. With us the difficulty is that sometimes men are born donkeys but do not appear to know it.

The old problem of how long it will take a frog to get out of a well twenty-one feet deep by jumping seven feet every day and then sliding down six feet at night, aptly illustrates the Buddhist's idea of the problem of existence. How many lives or succession of ages must one live in order to get into the final haven, or Nirvana, whatever that is, is the question. He believes this depends chiefly upon his own conduct, hence the belief has the tendency to restrain the vicious to discipline. How well this motive succeeds is apparent when we consider the unmatched population, both in numbers and in poverty, and then consider the comparative immunity from crime. True, the civil law punishes crime

severely; but so it does in other countries, but this is thought not to be sufficient.

In China, where there is not a burglar-proof safe, and no constant surveillance of policemen, there is comparative security to life and property. It is apparent that the belief in the transmigration doctrine has a repressing influence in this direction. But the people are not, as a rule, as good as their religion would make them if it were practiced. But in this, again, they are not peculiar. The masses are grossly ignorant and largely brutalized by ages of tyranny and poverty; yet they plod on in patience and industry, waiting their final rescue from existence.

The bible of the sect is not without beauty and high moral as well as poetic conceptions. There is much in it of the nature of mythology and mysticism, which Buddhists do not pretend to understand themselves, yet there is much to admire. From a book of extracts and translations from the Buddhist bible I give a few examples:

"The perfect man is like the lily, unsoiled by the mud in which it grows." Another: "The perfect man will not be angry with him who brings him evil reports of himself, lest he be not able to judge truthfully of the matter whereof he is accused." Its moral code contains such rules as "Do not steal"; "Do not lie"; "Do not kill"; "Do not be a drunkard"; "Do not to another what you would not wish done to yourself." From these examples it may be observed how nearly their moral law runs parallel with our own; and that this has exerted a potent influence in forming the Chinese character is evident. Also, that they cover the cardinal rules of right living in good society, none will question.

The system offers motives in the way of rewards for right living, and punishments for evil-doing. It develops sympathy, the source of many virtues. It teaches the equality of all men. One man is better or worse than another only as he observes the laws of good society or breaks them. That it satisfies the minds of its votaries is certain. The Chinese will never abandon this ancient faith on sentimental grounds. They must be convinced that a better system is offered before they accept it.

Whether this demonstration is forthcoming, remains to be seen. Strong efforts are being made in that direction, and the future alone will reveal the outcome.

REAR-ADMIRAL BELKNAP, of the United States Navy, combining his discovery of the greatest oceanic depths yet found in the Japanese Kuro Siwo with what other explorers have found in different oceans, announces the conclusion that, "as a rule, the deepest water is found, not in the central parts of the great oceans, but near, or approximately near, the land, whether of continental mass or island isolation."

SHETLAND PONIES.

THE Shetland pony has been invested with a halo of romance somewhat out of keeping with the prosaic surroundings of its native home; and this, apparently, from a very early date, for we chanced to read not long ago that, traditionally, "the Shetland pony was carried from the Caucasian range, by ancient worshipers of Odin, to Scandinavia, thence to Shetland"—in which tradition we discern a trace of humor, if nothing more, as, considering the size of some of these animals, they are much more fitted to be "carried" than to transport any one, whether from the Caucasus or elsewhere. But this is not all. Not only is the origin of the breed thus presumably lost in the mists of antiquity; a number of popular misconceptions also prevail in regard to the present-day nature and habits of the animals, all of which it seems desirable to correct. They are now not only drafted annually in large numbers to the south, but are extensively shipped abroad. A few words, then, in regard to the breed, as it exists to-day, may not be out of place.

To begin with, we must contend—in opposition to the popularly received belief—that there is no such thing as *the* genuine Shetland pony, in the sense of a single pure and original breed. There happen to be several distinct kinds in the islands, and these, besides being subject to natural variation, have been further increased in number by crossing. Crosses apart, however, an Unst pony is very different from a South Mainland one, while both of these again differ from a Fetlar specimen. There are also Fair Isle and Bressay varieties. It would be invidious to seek to indicate in this paper which of these is to be considered the best. Each kind, no doubt, has its special excellences, but a sufficient latitude is perhaps allowed when we state that a pure-bred pony may be anything between, say, thirty-six and forty-eight inches high at the shoulder. A small-sized pony, again, is not necessarily any better or more valuable than a large one; though for certain purposes, such as working in coal-mines, the smaller animal only is employed. As a general rule extremes of size, either way, fetch correspondingly extreme prices.

Broadly speaking, the ponies to be seen throughout, say, the mainland of Shetland—and they are to be met with everywhere, in spite of reported scarcity—may be divided into two classes, those kept by large breeders, generally in fenced parks, and the proletariat class employed by the peasantry in labor. Strings of the latter may be seen any day upon the roads, dragging peat-fuel from the hills in Lilliputian carts. They are wonderfully tough and strong for their size, live upon hard fare, and require, or at

least receive, little attention. Numbers of them live out of doors all the year round, except in the severest weather. The time-honored fiction that they are habitually left out in the snow, and preserve themselves from being drifted over by walking constantly in a circle, contradicts itself. As a matter of fact, snow often lies for seven or eight weeks in Shetland, covering the ground to a great depth. Under these circumstances the animals, if exposed, would certainly succumb, and they are far too valuable to their owners for this to be permitted. But they certainly do rough it out of doors in very inclement weather, seeking the doubtful shelter of dikes and out-houses; while in hard seasons the stud of the breeder is carefully housed in sheds made for the purpose. Unquestionably these ponies can stand a great amount of exposure, being fitted for this by a double or treble thickness of coat. But it is very much to be questioned—the popular belief to the contrary notwithstanding—if any of them are the better for being subjected to an extreme test of this kind. Ponies sent south at an early age rarely, if ever, pass through such an ordeal, and it is not found, we believe, that *their* natural hardiness deserts them, or even diminishes, when they receive fair treatment and proper shelter during inclement seasons. If stabled, however, as in many cases they must necessarily be, by the southern buyer, they should have abundance of fresh air; a simple shed, by way of cover, is almost all that is necessary for them. And it is imperative that at all times they should have ready access to drinking-water. No animal can exist so short a time without it unharmed. It is self-evident that, if a pony be entirely dependent on outdoor feed, his condition must necessarily vary with the season. Apoplectically full in summer, he must be sorely reduced in winter. This must, sooner or later, injure the health and stamina of the animal.

A Shetland Pony.

The writer, who has had considerable experience in the keeping of Shetland ponies, has carefully experimented as to the best hygienic arrangements for their indoor accommodation. He finds that a rough stone building, loosely cemented, so as to allow a free current of air to pass through the walls, with ordinary stable fittings on a small scale, and covered with a galvanized iron roof, forms their best shelter. During the day, in almost all

weathers, they should have their heads loose, in rough pasture; and in summer they can safely be left out at night, with the exception of young foals. Strange to say, the latter are remarkably delicate. For indoor food common wheaten bran made into a mash, with the addition of a little Indian meal, suits them much better than oats; while hay or straw, with turnips or potatoes, and perhaps a little linseed cake, complete their stable dietary. Generally speaking, they are somewhat gross feeders, and, though capable of standing unharmed a surfeit which would ruin an ordinary horse, they should have a carefully measured allowance, varying according to their size and to the work they have to do.

Now, as to the much-vexed question of height. A variation of, say, three hands between the average large and small sized ponies means a good deal in the case of such a tiny animal. Yet it obtains, as we have said, among undoubtedly pure-bred specimens, and entirely independent of any foreign cross. Accidental variations of size occur, of course, in breeding, and may be perpetuated, though this is not always to be relied upon. The true explanation, according to one of the most experienced of Shetland judges, is that size is mainly, though perhaps not entirely, a question of *feed*. Scanty feeding on hard pasture tends to diminish the height, and also to develop that superabundance of hair which is popularly (though erroneously) regarded as one of the distinguishing marks of the genuine strain.

The craze for undersized ponies, in our opinion, has had its day. Except as curiosities, or for the purposes of the *ménage*, these pygmy animals are practically useless. The conventional Shetland pony—the animal represented in picture-books—namely, about forty to forty-four inches high, very tight-jointed, and with an impossible growth of hair all over him, is just about as bad a type of this famous race as can well be imagined. From his build he is generally short-winded and thoroughly impracticable in his paces. A South Mainland specimen, on the other hand, long and rakish in build—hard-grown, as the saying is—and clean-limbed, will far surpass his companion in staying power. One of this hardy breed—in our opinion the ideal Shetland pony—has been known to travel from Sumburgh to Lerwick and back the same day, with a tolerably heavy riding weight, say fifty-six miles altogether of extremely hilly road. But, minor differences apart, there *are* certain characteristics—unfailing tests in their way with the experienced judge—which go to the "make-up" of a Shetland, as distinguished from an Iceland or Faroe, pony—e. g., a certain unmistakable breadth of build, set of pasterns, and, more particularly, an apathetic air which no other breed possesses. Your "Sheltie" is not a quick animal, is inclined to be sleepy rather than otherwise in his paces, and is, as a rule, disposed to do no more than he

can help in the way of exertion, though, if put to it, he evinces great power of endurance, and will go through an immense amount of work for his size. The Iceland variety is altogether inferior, shorter-lived, narrower in build, and generally fallacious, but, with all this, he is quicker, livelier, and lacks that air of pensive melancholy which haunts every Shetland pony. Our advice is to avoid the inferior animal, however highly recommended. Their price is, roughly speaking, about half that of the Shetlander, but the money is ill-saved. The average life of an Icelander is about twelve or thirteen years, while the other will live to twenty-five or even more.

During the earlier months of spring, before the snow has fairly disappeared from the Shetland uplands, the American buyer travels over the length and breadth of the isles, picking up every likely animal he can find for the foreign market. In order to secure a good selection it is necessary to forestall him. Hence mid-winter is the best time to buy. Just at present there is a comparative scarcity of fine animals in the islands. Within the last three years, and even before that, a disease affecting the ponies, incurable save in the earlier stages, and called sarcoptic mange, ravaged many districts. Infected animals were freely slaughtered, and the epidemic may be said to have spent itself. Still, the ponies are fewer than they once were, and the price all round is considerably higher. At present it may be said to range from £10 to £30 and upward for three-year-olds. It is impossible, however, within the limits of this paper to instruct intending buyers. The prices are very variable, as the animals often pass through several hands before reaching the ultimate purchaser. The latter will probably be victimized if buying from so-called agents in the south, as the latter will endeavor to extort £18 or £20 for an animal which has cost them little more than half that sum in Shetland. The only safe plan is to purchase through a respectable dealer on the spot.

The variety of coloring in these tiny animals is extraordinary. Almost every possible—and some all but impossible—shade of horse color may be seen during a day's ride through the mainland, from the lightest fawn, almost white, by gray and slaty shades of gradation to brown and black. There are no dapple-grays that we wot of. There is a tradition, of the usual value, that brown is the "true and original" hue. Cream ponies, if otherwise good, fetch a higher price than others, as being a "fancy color," and the same may be said of "piebalds." The theory that light-colored animals are not so robust or hardy as dark ones is not borne out by observation. A stripe, or ribbon-like mark, down the spine is a sign of Norwegian blood, the infusion dating many years back. If the Caucasian legend is to be relied upon, however, the Norway pony is at least first cousin to the Shetland one.

A mob of ponies feeding together in the open air will use their heels to each other most liberally. This is a painful but undeniable fact, known to every breeder. When running wild on their native hills they are extremely pugnacious, and will fight most determinedly, not only with each other but with larger horses, frequently to the discomfiture of the latter. So far true, but our romancer—the Shetland Munchausen—goes on to affirm that if

> "Fib and Tib and Pink and Pin,
> Tick and Quick and Jill and Jin"

are but congregated loosely together in a shed, or other building, they will no longer quarrel. Amity will reign where hopeless discord formerly prevailed. We can only say, Try the experiment! We have. The whole thing is a baseless fiction. They are patient and enduring, these ponies of Linga;* in many cases they may be trained to a docility and sagacity almost human, but there is a point with most of them—such, at least, is our experience of them indoors as well as out—when their patience gives way to positive ferocity, and when once their blood is up they are not so easily pacified. An experience we once had with a recalcitrant riding pony in a rural smithy—it was his first shoeing—will never fade from our recollection, nor, we imagine, from that of the village Vulcan.

Never groom a Shetland pony as you would an ordinary horse. They should be well brushed, and their manes and tails combed; but the indiscriminate use of the curry-comb is positively hurtful to them. More especially is this the case if the animal is to be left much out of doors. Observe one of them in the open air on a wet day, and you will notice that the rain runs off his coat as off a duck's back. But if the "set" be removed, the coat will no longer be water-proof. It is scarcely necessary to add that, by immemorial custom, the mane and tail should be lightly trimmed and no more. Nothing can be more incongruous than the sight of one of them closely cropped. The tail should just be off the ground. So careful are Shetland dealers in this respect that we have often received animals dispatched by them with the tail thoughtfully tied in a double knot, in case of accidents on shipboard.

The Shetland pony is shy of a strange owner, and at first requires to be jealously watched in a new home, as being apt to bolt on the first opportunity. Unfailing tradition steps in here and gravely informs us that a straying pony, however far removed from the land of its birth, will invariably shape its course for the north—in the direction, that is, of its native home. Needless to

* Linga, or Heath Isle, the ancient name for Shetland, now on the *lucus a non lucendo* principle, heath or heather being practically extinct.

say that, by preference, it does nothing of the kind. As far as our experience enables us to judge, a straying pony, wherever it may be, traverses the line of least resistance.

We have said that they are exported in large numbers annually. The wonder, in our opinion, is that they are not still more extensively purchased. They are singularly affectionate and repay any amount of attention. Their uses are manifold, as they are capital saddle animals—one of forty-seven inches being quite up to an ordinary riding weight—are as a rule sure-footed and reliable, go well either singly or paired in harness, make the best of hill ponies, give little trouble, and are the most captivating of all possible pets. Take them all in all, they are by far the best of the pony race. Perhaps their only drawback is their almost infinite teachableness, which tends to make them acquire bad as well as good habits; but this is a question of training. In nine cases out of ten their breaking-in is intrusted to inexperienced boys, with the usual result of developing a tendency to shy or to throw their rider, at which latter manœuvre they may become perfect adepts. These tricks are never unlearned. But, with an ordinary amount of skilled attention from the first, they may be perfectly disciplined.

Mr. J. Sands is the poet of this special subject—perhaps the only singer the Shetland pony ever had. In touching verse he pictures the mother pony with her downy foal feeding together on the wind-swept grassy hills of Shetland, the latter soon to be parted from her to go to work in the grimy coal-mine. A fine touch of nature this, but not without its share of, apparently inevitable, fallacy. For mine-ponies, though certainly condemned to life-long imprisonment, are well looked after and carefully tended. Assuredly their lot underground is preferable to ill-treatment above ground, and though a pony may suffer from something like "home-sickness" for a few days in a new dwelling, the attack seldom lasts long. Our pony, though somewhat of a pessimist, is a philosopher, and adapts itself with wonderful facility to a change of home and ownership.—*Cornhill Magazine.*

One of the traits of recent historical investigation, which is well illustrated in Welzhofer's History of the Early Greek People, is its reaction against the skeptical school of inquirers. The disposition to disbelieve the old stories, or to resolve them into poetical fancies, is giving way to speculations concerning the real facts on which they may or are supposed to have been founded. Mr. F. T. Richards suggests, in the Academy, that anthropology has done something to bring about this change of mind, by finding, still existent, institutions, incidents, legends, and states of mind closely parallel or akin to early Greek and Roman affairs; while the credit of many of the old stories is strengthened by incidents in which the unlettered traditions of savages have been found to be true.

SKETCH OF JEAN-CHARLES HOUZEAU.

THE romantic incidents of M. Houzeau's career in the United States must invest his story with a living and lasting interest to all Americans. His scientific record is no less remarkable. In versatility, variety of studies, industry, productiveness, and originality he has been surpassed by few men of science. The materials for this sketch have been drawn from the affectionate and appreciative Notes biographiques of Houzeau's intimate friend and associate, M. A. Lancaster (Brussels, 1889).

JEAN-CHARLES HOUZEAU DE LEHAIE was born at L'Ermitage, near Mons, Belgium, October 7, 1820, and died July 12, 1888. He was the elder of two children; his brother, M. Auguste Houzeau, is a professor of the School of Mines in Mons and a member of the Belgian Chamber of Representatives. His mother was still living in 1889, at the age of ninety years; but his father died in 1885, ninety-five years old. His name was regularly published in the annual list of nobles in the Almanach royal. The family had added *De Lehaie* to their name about the middle of the last century, to distinguish them from other branches of the same stock.

Jean-Charles Houzeau showed very early an inclination toward the branches in which he became famous. He was interested in astronomy even before he had learned to read; and with the bonbons that were given him he would form on a table groups of geometrical figures intended to represent the constellations. When he had the table covered with them, he would call his friends in to look at his firmament. He attended the college at Mons while from twelve to seventeen years old; and in the last year received a special prize. He then applied for admission to the University of Brussels, but failed to pass the examinations. He returned to Mons, where he was allowed to pursue his astronomical studies and ramble over the fields at will. From this time his mind was always on the alert, and he showed uncommon faculties of observation. With his own hands he constructed a small observatory on a neighboring hill. It included a wooden cabin in which were a mural circle, a transit instrument, and a telescope. The tubes of these instruments were of zinc; the glasses, which were not achromatic, were bought in Paris. He also began to write about this time, and contributed to L'Emancipation, of Brussels, numerous articles on subjects relating to improvements in industrial arts. He published his first scientific work in 1839, a pamphlet of 108 pages on turbine wheels, which can not be found now, but which was regarded by competent men at the time as of great practical value.

In the two following years, 1840 and 1841, Houzeau attended

the courses of the Faculty of Sciences in Paris, but did not seek an academic degree. On his return home, in 1842, he put himself into communication with Quetelet, to obtain a position in the observatory at Brussels, and was appointed a voluntary aid. He had already written a note in the Astronomische Nachrichten, on the position of the zodiacal light, which is cited by Humboldt in the first volume of the Cosmos; but so unknown was he to the scientific world at this time, that Schumacher, the editor of the Nachrichten, wrote to Quetelet to know who he was; and Quetelet was obliged to reply that he knew as little of him as his colleague.

In September, 1846, Houzeau was promoted to a recognized position in the establishment and a salary of fourteen hundred francs. The industry with which he attended to the special duties of this position is illustrated by the fact that during the three years that he held it, he, who had been so frequent a correspondent, did not contribute a single paper to the Academy. The reports of the director, however, amply attest the esteem in which he held his assistant, and the value of Houzeau's services in the work. Some of the fruits of his labors here are embodied in Quetelet's Climate of Belgium, in the preparation of which Houzeau had a large part. The astronomical observations had been interrupted for seven years, when Houzeau took hold. He contributed much to their resumption in 1848. He was usually the first one at the observatory, when any notable event among the stars was announced, to point the telescope at the designated object. Thus, in 1848, he was the first person in Belgium to determine the elements of the orbit of a comet from observations made in the same country; and, on the discovery of Neptune, he at once took observations for the determination of the new planet's right ascension and declination. In 1847 he was charged by the Government with the conduct of geodetical observations on the northern frontier, of which a few points remained to be determined. But his usefulness as an official astronomer was suddenly interrupted by the political events of 1848. Houzeau was a warm republican, with inclinations toward socialism. He had already, in 1839, when hardly twenty years old, been warmly interested in a dispute which arose with Holland, and had been among the first to join a company of volunteers for public defense. On the present occasion he gave free and unambiguous expression to his democratic principles and republican aspirations, and compromised himself by forming relations with persons whose political standing was not good. He published numerous polemical articles in the journals. On the 25th of March, 1849, a meeting at which he was presiding was broken in upon by the Leopoldists, and he and his fellow-republicans were obliged to flee. A few days afterward he was deprived of his position at the observatory for having, the

decree read, "assisted at meetings organized for purposes contrary to the institutions of the country." Quetelet was discommoded by the action of the Government, and did not conceal the fact. Houzeau continued, however, to take part privately in the work of the observatory for a few months, till he started on a tour in Germany, Switzerland, and France. Sojourning at Lyons from the following February till May, he occupied himself with the preparation of several works, among them two treatises on Meteorology, which appeared afterward in the Encyclopédie populaire. In May, 1850, he settled in Paris, where he resided for five years, devoting himself principally to study. He was an industrious taker of notes, which related, not to science alone, but to all branches of human activity, and embraced anecdotes and jokes. He assisted M. d'Abbadie, of the Institute, in arranging the scientific observations which he had made in Ethiopia. He interested himself much in optical telegraphy. In conjunction with his brother he made experiments at Paris and Mons to learn if the light of the flashing of powder at one place could be seen at the other. Of course, these experiments were not successful, for such lights could not be seen at so great a distance. Some time afterward communication by the electric cable between England and France was interrupted, and Houzeau proposed to the English Cable Company to use a system of optical signals. Experiments were determined upon between Dover and Calais, but were stopped by the order of the French Government, declaring that such work should be done only by agents of the state. They were undertaken again in England, where this kind of interference could not take place, between Southend and Whitstable. The first experiments were successful, but the populace, excited by so much night-work with fires, and fancying that the oyster crop would be damaged by them, mobbed the experimenters and stoned Houzeau's lodgings.

The essay on the Physical Geography of Belgium (1853) was the first book, M. Lancaster says, in which Houzeau "gave the measure of his force as a man of science and a writer, and in which one could perceive the whole extent and variety of his knowledge, appreciate his expository talent, and enjoy the charm of his sober, clear, and elegant style." He had been collecting materials for it for ten years, and in doing so made the best use of his pedestrian excursions. The book is possessed of an interest that does not pall for an instant in the reading, and is described by M. Lancaster as one of the most remarkable works that can be cited. An important paper in the same line was a study of the influence by which the peculiar features of the relief of Belgian topography had been produced. In 1854, through the influence of his friend and former colleague, Liagre, Houzeau was temporarily commis-

sioned by the Minister of War as astronomer to determine latitudes and azimuths and make geodetic observations in the triangulation of the Belgian coast. He performed this work with great credit to himself and advantage to the service till 1857, when, the appropriations failing, he was dismissed. About this time (1857) he published his History of the Soil of Europe—the most important work he produced prior to crossing the Atlantic. It was accompanied by a map which deserves mention as embodying the first attempt that was made, with a satisfactory degree of success, to represent the relief by curves and by successively deeper tints of shading. Berghaus had previously attempted a map with relief curves, but it left much room for improvement.

After his dismissal from the work of triangulation, Houzeau proceeded to carry out a desire which he had cherished for many years to visit the United States, where he expected to study a society and customs different from those with which he was acquainted. He embarked from Liverpool on an emigrant sailing vessel, on the 11th of September, and reached New Orleans after a voyage of seven weeks, much of the time marked by hard storms. He expected to remain in America a few months. His residence actually lasted twenty years. Full accounts of his experiences and observations during the first ten of those years are given in his twenty-four communications to the Revue trimestrielle. The letters, treating of many questions, constitute, for the time in which they were written, a complete, vivid, and animated picture of the manners and institutions, and the social, political, and intellectual conditions of the districts in which he abode. The question in which he appears to have been most deeply interested was that of the abolition of slavery. After staying at New Orleans long enough to get a passable practical knowledge of the English language, he went to San Antonio, Texas, where he was engaged in surveying for irrigating canals; then made a six weeks' excursion to the Rio Grande, during which he found abundant opportunities to carry on studies of the winds; he was interested in observations of Donati's brilliant comet and speculations as to its identity with the comets of 1264 and 1556; and was commissioned to make surveys in western Texas for the settlement of some Spanish land titles which had been acquired by a company. He describes his life here as that of the regular frontiersman.

When the civil war broke out, Houzeau was in southern Texas, about to start on a geological excursion to the borders of the Indian country. The trip occupied six weeks, and, on his return, he seems to have got himself into some trouble by assisting in the escape of a fugitive slave. After resting a month, he started for another geological excursion toward the Rio Pecos.

But affairs had become too much disturbed for the undertaking to be safe, and he was stopped before he had made more than a few days' journey. Life at his ranch was imperiled by Indian depredations, and he was obliged to abandon all—even his books and his precious collections of Secondary and Tertiary fossils, his field and his cattle—and return to the towns. At Austin he was invited to join the staff of the Confederate army, to help supply a seriously felt lack of scientifically educated officers, with the inducement added that he would thereby be enabled to avoid requisitions. He answered: "I would sooner cut off my right hand than serve that cause. Let the requisitions come; they may watch me as an obdurate or make a prisoner of me, but a soldier of the planters—never!" He returned to San Antonio, where he hoped to be able to weather the storm in obscurity; but, being threatened with a conscription, he claimed the protection of the Belgian consul at New Orleans, without effect. There was a powerful party in the region opposed to the Confederacy, and he allied himself with it. Then came the arrest, in October, 1861, of Mr. Charles Anderson, Unionist, at the head-waters of the Rio San Antonio, with the accounts of which the papers of the time were filled. Houzeau, with a Northern lady, his neighbor, formed a plan to rescue Mr. Anderson, and carried it out with admirable daring and brilliant success, himself accompanying the suspect on horseback at night to a point down the river, whence a straight road led to freedom, and taking care of his business papers. Desperate but vain efforts were made to discover the "traitor" who had helped Mr. Anderson off.

In February, 1862, Houzeau learned that the Vigilance Committee were about to make a descent upon him. He had compromised himself by defending the freedom of the negroes whom Anderson had set free to prevent their being sold by Confederate officials. He prepared to flee, first taking care to write an account of the rescue of Anderson. Knowing that the Unionist party desired to send a memorial to the President of the United States, and wishing to be useful to them before going off, he told them that if they would prepare the memorial he would take charge of it. Not being able to carry his own papers with him, he burned them, for there was not a leaf among them, he said, that did not contain something in condemnation of slavery. With the Unionist memorial stuffed in the barrel of his shot-gun, he started off under the guise of Carlos Uso, Mexican driver of six oxen, in the train of Alejandro Vidal, for Brownsville and Matamoras. The story of the journey of thirty-five days, as told by him in his correspondence, reads like a chapter of Uncle Tom's Cabin. He had to remain in Matamoras nearly a year, till January, 1863, waiting for the French blockade to be raised, before he was able to take

passage for the United States. He spent his time in gardening, in drawing architectural designs for the rebuilding of the burnt city, and in making surveys of Matamoras and Brownsville for the consul of the United States. His house sheltered many Texan refugees. At last the American war-ship Kensington appeared at the mouth of the Rio Grande, and Houzeau was given passage on her to New Orleans as a member of the Belgian Academy of Sciences. At New Orleans he identified himself with the interests of the colored population, and became a regular contributor and one of the editors of their French journal, the Union, afterward the Tribune, to which he added an English part. He came north in July, 1863, and resided in Philadelphia till November, 1864, pursuing scientific and literary studies and preparing his book on the Mental Faculties of Animals as compared with those of Man, which was published in 1872. Then he returned to New Orleans and took charge of the Tribune, which became, on the strength of his famous article, Is there any Justice for the Black? one of the best known and influential journals of the country, contributing to it some eighteen or twenty columns a day. He presided over the Republican Convention of July 30, 1866, which was mobbed, and barely escaped from it with his life by the aid of a back passage. In the next year a division arose among the parties interested in the Tribune, with which Houzeau would have nothing to do, and he retired from it.

Houzeau had hardly landed in the New World when he received the offer of a professorship of Geology in the Free University of Brussels. He declined, but his name was put upon the programmes and kept there for two years, while efforts were continued to induce him to accept. He was disposed to consider more favorably the offer of a position in the military school, made in 1863, but the financial limitations of the institution prevented the consummation of the appointment. No settled intention, but accidents arising one after another, kept him in America for twenty years. He formed plans to return to Europe several times, but something occurred to postpone the day. In the mean time his literary and scientific activity suffered but little interruption. He contributed to three or four journals sketches of travel, American life, the Indians, the war, slavery, etc., and to the scientific societies and journals papers on the numerical calculus, the radius vector of a new planet, parallax, stellar movements, and other subjects; and, while busiest on the New Orleans Tribune, he taught stenography to a school of colored men, and corresponded with the New York Evening Post.

A few weeks after giving up the New Orleans Tribune, Houzeau removed to Jamaica, where he found a new life of freedom opened up to him with ample opportunities for study. He took

a house, with a few acres of garden, at Ross View, near the foot of the Blue Mountains, and there led a life of seemingly pure enjoyment in his work, varied by excursions, of one of which, to the higher mountain regions, he has left a full and most entertaining account. The colored people of the neighborhood had borne a bad reputation, but Houzeau found them the best of neighbors. He gathered them around him and taught them the rudiments of science and something of literature. He taught the children to read, and found by his experiments that the old way of spelling the words out was better adapted to their mental condition than the "philosophical" one by presenting syllables and words to be learned bodily. He set up a printing-press, from which he issued a numerical calculator, a table of logarithms, a perpetual almanac, Families of Plants, and Correct Information about Common Things, some of which works, however, were not completed. The scientific journals were well supplied with the articles which he produced during this period. The principal of his works was the Study of the Mental Faculties of Man and Animals, on which he had labored for several years. It was warmly commended by Mr. A. R. Wallace, who said it gave the author a high rank among philosophical naturalists, and by Mr. W. Lauder Lindsay, who regarded it as the peer of Darwin's works. The Sky brought within Everybody's Reach was a clear, interesting, and at the same time scientific popular treatise on astronomy. He improved the favorable situation he enjoyed at Ross View for new observations of the zodiacal light, and, perceiving the advantages which a pure atmosphere afforded for his work, conceived and expressed the idea of seating observatories on the tops of mountains, which has since been carried out at several places, with all the good results he anticipated. He undertook in 1875 the preparation of a uranography, or map of all the heavens visible to the naked eye. In order to enlarge the field of his observations he spent a few weeks at Panama, and there, suffering from fever, contracted, in the service of science, the seeds of the disease that carried him off a dozen years later.

M. Lancaster thinks that Houzeau would have spent the rest of his days in Jamaica, if the death of Quetelet in 1874 had not prompted his recall to be the head of the observatory of Brussels. As it was, he found, when he returned to his home from Panama, a telegram announcing his appointment as director of this institution. The observatory had not of late years—Quetelet having been partly disabled by an apoplectic stroke suffered in 1855—kept up with the times. Its instruments had grown old-fashioned, and there was a lack of energy in its work. A commission was appointed after Quetelet's death to inquire what could be done to restore it. All agreed that a man of vigor was needed,

and Houzeau's friends had no hesitation in asserting that he was the only Belgian who could supply the requisite faculties. But there was much against him. He had been long away, and was politically discredited and unorthodox. Even when his nomination had been put into the hands of the king for the royal signature, the ministers interposed objections. "He is a freethinker," they said. "That is a matter for his conscience," the king replied. "But he is a republican, too," they added. "That is my business," said Leopold, and wrote his name confirming the appointment. Even Rogier, who was responsible for Houzeau's dismissal in 1849, told the king that, if he were now minister, he would appoint him. "I owe him a reparation," he said.

Houzeau took charge of the observatory on the 17th of June, 1876. His views as to the renovation of the institution were approved. New instruments were obtained; the meteorological department was fitted up; a spectroscopic department was instituted; a daily meteorological bulletin was started, which he attended to personally for the first six months; popular lectures were instituted, the library was enlarged, new life was given to the publications, a catalogue was made of the astronomical and meteorological works in Belgian libraries; Ciel et Terre, one of the most valuable scientific periodicals of Europe, was begun, and vigorous activity was instituted in every department. During the six years that he remained here he published The Study of Nature, its Charms and its Dangers; his General Uranometry; an Elementary Treatise on Meteorology (with M. Lancaster), and special papers. In 1878, as Vice-President of the Geographical Society, he received Mr. Stanley on his return from his Congo expedition.

Houzeau revisited Jamaica, spending five months there, in 1878. In 1880 he was delegated as the Belgian representative in the Meteorological Congress at Rome, and visited Italy for the first time. In 1882 he led one of the two Belgian expeditions to America—one to Texas and the other to Chili—to observe the transit of Venus. Visiting San Antonio again, he gave lectures there on scientific subjects, and particularly on the transit. He had found the climate of Belgium too severe for his enfeebled constitution, and determined not to return there. He came back to France, and settled down for a year at Orthez, near Pau; then, wishing to be nearer to Brussels and to libraries while preparing his Astronomical Bibliography, removed to Blois. In November, 1883, he resigned his position in the observatory. His father dying in August, 1885, he resolved to return to his native land to take care of his mother, to whom he was always a dutiful son. The demands of his Astronomical Bibliography obliged him to go to Brussels, where his labors on that important work were varied by occupation with his Annuaire populaire, lectures for

the geographical and microscopical societies and societies of art, and with writing articles on political and social economy for the journal Réforme; in addition to which he projected a great work on the Beginnings of Science. At the same time his health grew worse, and in the fall of 1887, while his general appearance was still not changed, he expressed to his friends the opinion that he would hardly live through the winter. He was confined to his bed in February, and died in July, 1888. He was buried, in accordance with his dying wish, in the most simple manner, in the public ground, with no stone to mark his grave. Nevertheless, a handsome monument, seven metres high, adorned on its four sides with appropriate astronomical and meteorological emblems, has been erected to him by the city of Mons, on one of its public squares, near the railway station, and was unveiled on the 2d of June, 1890, with addresses by the burgomaster of the city; M. Folie, Director of the Observatory; and M. Auguste Houzeau.

Most of Houzeau's principal works have been mentioned in the course of this sketch. His minor papers and special publications were very numerous, contributed to different societies and journals, and touched, as M. Lancaster well says, on nearly every branch of human activity. M. Lancaster's list gives eighty-six titles, counting as one matter contributed to the New Orleans Tribune enough to fill a dozen volumes. He was made a correspondent in the Class of Science in the Belgian Academy in 1854, and two years afterward a member of that body. He was a member of several other societies in Belgium, Holland, Luxemburg, London, and Vienna.

Mr. Wallace expresses the opinion, in his Darwinism, that animals are spared the pain we suffer in the anticipation of death, and that their lives are, therefore, lives of almost perpetual enjoyment; even the watchfulness they have to keep up against danger, and their flight from enemies, are, he believes, the pleasurable exercise of the powers and faculties they possess. Dr. R. W. Shufeldt, after many years of incessant study of animated forms of high and low degrees in the systematic scale, has come to very different conclusions from these. He believes that there has been as much evolution of mind, or reasoning powers, in animals as of organic structure; and that while the anticipation of death in the ordinary course has very little to do with marring the pleasures of life among men or animals, the immediate presence of death is awful to both. Instances are not wanting to prove that most of the higher animals appreciate the difference between a living and a dead body, and realize much of the suffering due to the fear of death as apart from the physical pain that may accompany it. In the case of flight from an enemy, or in the face of any other danger that may result in death, Dr. Shufeldt is convinced that the animal pursued, be it man or some of the vertebrated forms in the scale below him, experiences very much the same kind of sensations. Those who have studied timid animals under such circumstances "know full well that their pleasures in such flights are by no means unmixed ones, but are rather infused with a very large share of pain, and pain of a very high order."

CORRESPONDENCE.

"WHAT SHALL WE DO WITH THE DAGO?"

Editor Popular Science Monthly:

MR. APPLETON MORGAN'S query, in the Monthly for December, What shall we do with the "Dago"? suggests many other questions. I presume the writer did not design that his description of the "dago" should be regarded as typical of the Italian people, or of any considerable part of them, but only intended it to apply to a peculiar variety of the dangerous classes that happens to come from Italy; but his paper is, unfortunately, liable to the former offensive interpretation, and has, I happen to know, been taken in that sense in at least one quarter. Few will venture to dispute that Mr. Morgan's *lazzaroni* are as dangerous as he describes them; but it is hardly fair to regard them as the legitimate products of Italian nature. If we review the history of Italy, we shall find that it has been most conspicuous as the progenitor of a very different class of men.

Classes of outlaws, like the bandits and assassins of Italy, rarely appear prominently in any country that enjoys its own government. They are a result of foreign rule, under which even good citizens may come to regard the Government as their enemy. We do not find them in England, or France, or Germany, or Scandinavia, but in Ireland, in Hapsburg- and Bourbon-ruled Italy, and in the European countries under Turkish sway. If we regard them in Italy, we shall find them most prominent and dangerous in those states of the south that were longest and most continuously under Bourbon dynasties, as in Naples, or Austrian, as in the central states.

No European nation, excepting Greece, has done more for civilization and few for liberty than Italy. About twenty-six hundred and fifty years ago a band of natives emigrated from the "Long White Hill" in Latium and went to a group of hills on the Tiber and built them a new town. It would be a needless relation of a very old and universally known story to tell how Rome grew and conquered all the known world west of the Euphrates, tamed savages and squelched tyrants, and carried civilization to every quarter of its vast dominions; to describe the buildings it erected, the cities it founded, and the roads it constructed; to name its long roll of illustrious men—warriors, statesmen, popular tribunes, orators, artists, and authors; its more illustrious women, typifying all that is best in the sex; or to speak of its laws, the principles of which lie at the foundation of most of the European codes. These men, the authors of these great works, mostly came from the same stock as Mr. Morgan's "dagoes"; for, as fast as one set of great men or noble families died out, others rose or were promoted from the ranks. Rome has been called and is called the "Eternal City." It has always, since two centuries before Christ, been the source of the strongest influences by which the world has been ruled. "Roman virtue," "Roman honor," and "Roman firmness" are living proverbs.

After the Western Roman Empire was destroyed and Europe was subjected to barbarian despots, there were still free republics, civilization, and literature in Italy. These republics lasted till they were overthrown by foreigners, some holding out till the beginning of this century. Communication was kept up with the Greeks at Constantinople, and the light of literature and art shone in Italy through all the darkest of the dark ages. The history of these republics is full of brilliant deeds and illuminated by the names of men distinguished in various lines, and heroes, the details of whose history are now hard to find, but of which the mere references in Dante's poem furnish a long catalogue.

Considerations of space forbid more than a mere reference to the splendor of Italian achievements in literature and art from Dante's time till the fifteenth and sixteenth centuries. The story is familiar. The history of the world affords but one parallel to it—Greece in the age of Pericles.

Four hundred years ago there was an Italian who made himself a great nuisance. He had conceived the idea that, if he should sail west on the Atlantic, he would find something worth going after. He bothered the Pope and he bothered the King and Queen of Spain till they were distracted to know what to do with him; and Ferdinand and Isabella at last gave him ships as the easiest way to get rid of him. We are inviting all the world to come over here two years hence to help us do his memory the highest honors in our power; and there is a rivalry between us and Spain as to which shall give him the greatest honor.

Another Italian—he was born in Corsica—although he was no doubt a bad man, about the beginning of this century struck the blows which resulted at last in freeing Europe from the despotisms and the doctrines of despotism which had cursed it for a thousand years.

How will it be possible, in less than a volume, to do justice to what the Italians have done in the last forty-five years for the

freedom of their country and for human liberty? At the beginning of this period Italy was, as Talleyrand had said, with a sneer which was also truth, only "a geographical expression." It was divided up among some dozen or twenty foreign sovereigns, some of whom were of very low degree, and all used their power for dynastic ends only, regardless of the sufferings of the people. This was and had been for centuries just the condition to breed *lazzaroni* and bandits. One sovereign away up in the northwest, a man of the country, had ideas beyond his family, and thought of the people. With him and his son Victor Emanuel as chiefs, and the great native hero to urge them on and compel them when they would not be persuaded, and Cavour to organize, the long battle was fought of the people of Italy against the world. The people of Italy triumphed and founded a kingdom than which no modern state is more enlightened or progressive. This great work of persistent heroism and its crowning success are the achievement of the common people of the country—the "dagoes"—and no one else, with no help except what they compelled. Its champions, Victor Emanuel, Garibaldi—whom Mr. Morgan's "dagoes" in person resident in America have honored with a creditable bronze statue—Cavour, and their associates, are counted to-day among the world's noblest men. We might speak of Italian music and of Italy's contemporary literature and science, which occupy no mean position, but we have said enough. What shall we do with the dago? Give him a chance.

W. H. Larrabee.

Plainfield, N. J., *December* 10, 1890.

EDITOR'S TABLE.

RELIGIOUS TEACHING IN THE PUBLIC SCHOOLS.

FOR good or for evil, education is now very generally regarded as a function of the state, and has, in point of fact, been assumed by the state to such an extent that private enterprise in the matter of education is reduced to an altogether secondary *rôle*. One drawback to this is that questions of school management have now become, in the main, questions of politics. When we ask, "What should the schools teach?" we mean, as a general thing, "What, as parties and votes are balanced, is it practically possible and desirable for the schools to teach?" We are strongly of the opinion, for our own part, that this is not a satisfactory position of the question. Had education been left untrammeled by state interference, we should have had many different types of schools, and many different experiments made by different teachers. Instead of discussing the question as to what the schools should teach in a good deal the same way as a political convention would canvass the merits of rival candidates, we should content ourselves with noting what the schools were teaching, and with laboring individually to bring this or that special conviction of our own on the subject of education into practical recognition. Under the present system we do not inquire what makes or would make for full intellectual and moral development, but merely what courses of study will be free from objection on the part of this, that, or the other section of the electorate. This is part of the price we pay for state education.

Well, there is nothing to do but to make the best of things as they are, and it was perhaps a wise thing on the part of the Presbyterian Synod of New York to summon a conference of representatives of the different Protestant churches to discuss the question as to the extent to which religious instruction might and should be imparted in the public schools, regard being had to all the circumstances of the case. Now that the conference is over, it is sufficiently evident that the views of those who would introduce more or less of theological doctrine into the schools can not prevail. They can not prevail, simply because the conditions necessary to their success are absent. "The stars in their courses fought against Sisera," and the stars in their courses, or at least the influences of the time,

are fighting against those who would make the state the teacher of any system of theological doctrines however elementary or fundamental whatsoever. The most striking address delivered in support of religious teaching was that of Dr. William A. Butler, who took up the position that, while in this country there is an absolute divorce between church and state, there never has been any divorce "between Christianity and the state, or between the state government in its administration and the Christian religion, as revealed in the Scriptures." The inference which the speaker drew was that it was entirely lawful and proper for the state to sanction "the reading of the Scriptures in the public schools, without note or comment, as also the use of the Lord's prayer, and the inculcation, under proper safeguards, without admixture of human doctrine, of Christian morals."

This view of the case was vigorously combated by Dr. Ward, editor of The Independent; and, we must confess, it seems to us amazingly weak. Far be it from us to argue against religious teaching in schools under private control, or to assert or imply that the religious element is not a most important one in education generally. That was not the question before the conference, nor is it one with which we should think it right to concern ourselves. The question is, Can the state teach religion? Dr. Butler thinks it can, because there has never been any divorce between the state and Christianity. The reason is glaringly insufficient. A "divorce" means a tearing asunder; there has been no divorce between the state and Christianity for the excellent reason that there never was any union of a formal or legal kind to sever. A majority of the population, it may be assumed, are professed adherents of Christianity, but it does not follow from that that they have authorized the Government to give effect in any practical shape to such convictions as they may have on the subject. Before the Government can act, it must have a very clear mandate; and manifestly the people could not give the Government a mandate on this subject without stating clearly what they understood by Christianity, and with what degree of detail they wished its doctrines to be made matter of instruction in the schools. The idea of a government deciding such questions for itself is simply ridiculous. In certain cases, where technical knowledge is required, the state can call experts to its aid—architects, engineers, chemists, electricians; but imagine for a moment the Government calling for expert assistance in a question of theology! But to come down to facts, the people do not want the state to undertake any theological or religious business on their behalf. They know, they deeply feel, its utter incompetency in that sphere. They know that it is as much as they themselves can do in their several churches to avoid causes of dispute and separation; and they have not the most remote idea of inviting the politicians whom they have elected to office to make amateur theologians of themselves for any purpose whatsoever. The very idea is so incongruous with the spirit of the time that it is hardly worth while to insist on the fact that the Christian community is itself divided by the most serious differences of opinion upon various theological questions—so much so that, in the eyes of certain Christians, others who claim the name have no title to it whatever. The differences of opinion, for example, between Trinitarians and Unitarians, and between Universalists, who look forward to the salvation of all, and those who, as the Scotch woman said, "hope for better things," or between Roman Catholics and those who think that Roman Catholicism is "the beast" of the book of Revelation and the Papacy the "scarlet woman," are fundamental, and any religious teaching that was meant to gain equal approval from

these and all other sections of the Christian community would have to be very vague and non-committal indeed. The whole merit and force of a religious system consist in its teaching authoritatively that which would not otherwise be conveyed to the mind at all; while the essential character of any religious instruction which the state could give would be found in its vagueness and conventionality.

Well, therefore, did the Rev. Dr. W. H. Ward declare that "we may consider it as settled that religion is not to be taught in the public schools—that the American people will not trust the state to teach religion." Manifestly, to give a thing in a weak and diluted form which, to have any virtue, must be given in a strong and concentrated form, is to do more harm than good; and it may safely be said that, if through unwise legislation the formal teaching of religion were begun in the schools by such agencies as the state can command, the result would be disastrous to the cause of religion itself. Dr. Ward took what probably most of his hearers must have regarded as an extreme and dangerous position when he said that "morals do not depend on God"; but, as he meant it, we do not doubt that he expressed a truth. His meaning we take to be that the principles of morality are as capable of formulation without the help even of the theistic hypothesis as those of any other subject of human study. What, after all, are our ideas of God but the highest ideas which our human experience has enabled us to frame? There is no difficulty, then, in teaching morals in the schools without theology —no difficulty, that is to say, in laying down the rules of right conduct as a thing to be practiced here and now for reasons of present validity. But, as Dr. Ward judiciously observed, the best moral teaching will result from the observance of order and discipline, honor and justice, in the management of the school itself. Direct preaching is of doubtful utility; but example tells, and facts are powerful persuaders.

It is possible the late conference may lead some to perceive, as they never did before, the disadvantages connected with making education a branch of politics. In discussing education we should not have to canvass a political situation, but at present that is just what we have to do. And when we engage teachers for our public schools we engage them to follow a prescribed routine, not to throw all their original force and all their deepest convictions into their work. That the highest type of education is not to be had on this plan is evident; and whether the wider diffusion of education, due to state agency, is sufficient to make up for the deterioration in the quality of the article is a most serious question, which we believe the experience of each succeeding year will force more and more on the attention of the community.

INTERNATIONAL COPYRIGHT.

Every day is adding to the number of those who believe that ethical standards are the safest guides in the conduct of men's affairs. All such will find good reason to rejoice at the evidence of a dawning conscience in political circles afforded by the recent passage of the copyright bill in the House of Representatives. For nearly a century those citizens of the United States who believed in honest government have been more or less actively striving to obtain for the foreign author some sort of effective recognition of the principle embodied in this measure. Property in ideas, when these have been materialized in the form of books, has long been practically recognized, as well in the copyright laws of our own as in those of other countries. Yet for years, and in the face of this fact, we have suffered the disgrace of being about the only civilized nation on earth mean enough to refuse to make the principle interna-

tional in its application. Whenever it was proposed to do this, the enemies of the reform have raised the cry of "expediency," "the needs of the reading public," "the advantages of cheap literature," and other similar catch-words intended to mislead, while the ethical questions involved have been contemptuously brushed aside as unworthy of serious notice.

By its refusal to legislate on the subject in accordance with well-known principles in force in other countries, our Government, it is not unfair to say, tacitly maintained that, after all, stealing was quite the thing, or at least not to be interfered with, as long as it served the interests of a numerous class, and could be carried on without peril and to the profit of the thief. To plunder the foreign author became an innocent occupation: he was not one of us, and we stilled our consciences with the pretense that moral obligations were limited by geographical boundaries.

The decisive majority in favor of the new bill sharply discredits this belittling view of our duty as a nation. It also marks a most encouraging advance in public sentiment which is daily growing more and more appreciative of that rare variety of legislation which is founded on right and justice. There is good ground to hope that the bill will meet with equal success in the Senate, while the President, with his well-known devotion to principle, is already committed in its favor.

Yet, bright as the prospects for the early triumph of the measure appear to be, its friends and promoters can not afford to relax their efforts until the bill becomes a law Signs are not wanting that its enemies, so far from being discouraged by the present attitude of Congress, have rather been stimulated by it to renewed exertions in their desperate opposition to the reform. They are trying to create dissensions among its supporters, hoping by this means to weaken their influence in its behalf.

In view of this it should be remembered that few measures of the kind can be perfected until they have had a practical trial. It would be the height of folly to imperil the essential principle of the bill merely because some of its minor details did not exactly meet the views of all its supporters. The greatest need now is, that those more directly interested in the welfare of the measure should sink their differences, and, uniting with the friends of justice and honest legislation everywhere, should continue to urge the matter upon the attention of Congress until success has been achieved, trusting to time and experience, when need arises, to bring the several features of the law into closer harmony with the public interest.

LITERARY NOTICES.

OUTINGS AT ODD TIMES. By CHARLES C. ABBOTT, M. D. New York: D. Appleton & Co. Pp. 282. Price, $1.50.

IT is a pleasant task to review one of Dr. Abbott's books. The contrast implied in the title of his preface to this volume—"Nature and Books about it"—is reduced to the lowest point in his writings. The genial doctor has a happy faculty for transferring the charm of Nature to the printed page, that is the more valuable for its rarity. It might seem a mistake on the part of the author to put as the first of his four groups of essays the one headed "In Winter," for Nature in that season is by many regarded as wholly uncommunicative, if not frigidly forbidding. But Dr. Abbott does not find it so. Coming to an ice-fringed brook, in one of his winter outings, he quickly detects in the water "dainty little frogs—the peeping hylodes—squatted on dead leaves and yellow pebbles, and so spotted, splotched, and wrinkled were they that it took sharp eyes to find them. . . . The spirit of exploration seized me now," he says, "and I brushed the shallow waters with a cedar branch. Lazy mud minnows were whipped from their retreats, and a beautiful red salamander that I sent whizzing through the air wriggled among the brown leaves upon the ground. It was only after a hard chase that I capt-

ured it, and, holding it in my hand until rested, I endeavored to induce it to squeak, for it is one of a very few that has a voice; but it was not to be coaxed. It suffered many indignities in silence, and so shamed me by its patience that I gently placed it in the brook. Soon black, shining whirligigs—the gyrinus—suddenly appeared; and a turtle, as if wondering what might be the cause of the commotion, thrust its head in the air, stared angrily at me, and returned to its hidden home. There was no dearth of life in the brook, yet this is a winter day." Equally numerous does he find the birds in winter, and, in the right places, growing plants, with an occasional flower, if the season happens to be open. He sees, too, the meadow mice, skurrying back and forth in their grass-walled, ice-roofed runways. In spring, Nature's drama becomes more varied. Under the name of this season, Dr. Abbott discourses of the April moon, of small owls, of apple blossoms, etc., and even draws entertainment from such an unpromising place as a meadow mud-hole. In summer, and again in autumn, the scene changes, but all under such delightful leadership is intensely fascinating. Sprinkled through these pages are bits of reminiscence of boy life, not without its pranks, in a Quaker farmer's family; and digressions upon such topics as old almanacs, weathercocks, "skeleton-lifting," and fossil man in the Delaware Valley, occur here and there. The material form of the volume, with its narrow page and wide margins, and its tastefully designed cover, admirably fits the character of the matter within.

THE PRE-COLUMBIAN DISCOVERY OF AMERICA BY THE NORTHMEN, WITH TRANSLATIONS FROM THE ICELANDIC SAGAS. By B. F. DE COSTA. Albany, N. Y.: Joel Munson's Sons. Pp. 196. Price, $3.

A SCHOLARLY and entertaining work is this upon the Northmen and their Western voyages. The author was doubtless instrumental in arousing interest in regard to the Icelandic chronicles and literature by the publication of the first edition of this book in 1870, and he must view with satisfaction the progress made since that time, which has been emphasized in the erection of two statues to Leif Ericsson.

Fairly and candidly the author treats all evidence bearing upon the earliest knowledge of the American continent, even admitting that many facts point toward the Irish as the first to cross the Atlantic. Beginning with references found in Greek and Latin authors to "a vast island lying far in the West and peopled by strange races," he comments upon the exploits of Tyrian and Phœnician navigators. Cadiz, in Spain, was settled by Tyrian traders 1200 B. C.; in the ninth century there were colonies upon the western coast of Africa; and three hundred years later the continent was circumnavigated by the Phœnicians. A chart of the Canary Isles was made by Sebosus, 63 B. C., and a description of King Juba's expedition is furnished by Pliny. It is regarded as a possibility that the Phœnicians made transatlantic discoveries: "From the Canaries to the coast of Florida is a short voyage, and the bold sailors of the Mediterranean, after touching at the Canaries, need only spread their sails before the steady-breathing monsoon, to find themselves wafted safely to the western shore."

The first chronicle of any voyage to America is found in the Icelandic tongue. This language was spoken by the Northmen who settled in Denmark and the Scandinavian countries, but were at length oppressed in Norway by King Harold. Too proud to brook any curtailment of their power, the jarls sailed away to the frozen shores of Iceland. Here, in 868, they found Christian monks who would not affiliate with the pagan new-comers, but promptly gave up their icy retreat and "left behind them Irish books, bells, and croziers, from which it could be seen that they were Irishmen." In 982 Eric the Red, banished from Iceland, sought refuge in Greenland. Colonies were soon established here, and only eight years elapsed before Leif, the son of Eric, made his first voyage to Vinland. The Ericssons were a family of explorers. Thorvald and Thorstein, brothers of Leif, and Freydis, a sister, each undertook an expedition to the new land. The most important voyage was made by Thorfinn Karlsefne, an Icelander of famous lineage, who, with three vessels and one hundred and sixty men, visited Vinland and remained three years. Had it not been for the observant habits of the Icelanders, who were taught to study "the di-

visions of time and movements of the heavenly bodies," the location of Vinland might be a matter of doubt; but it is fixed not only by their description of the coast and character of the country, but by the account of Leif and his comrades, that "on the shortest day the sun was in the sky between Eyktarstad and Dagmalastad," periods corresponding to 4.30 P. M and half-past 7 A. M., making the latitude 41° 43′ 10″, nearly that of Mount Hope Bay. Ancient vessels that have been exhumed in Denmark, as well as measurements found in the Sagas, prove that the ships of the Northmen were able to bear them across the Atlantic. That no enduring structure marks their occupation of New England is not astonishing; according to the story of their sojourn, they lived in wooden booths.

The literature and general knowledge of the Icelanders were much in advance of the rest of Europe during the twelfth century, so that it is altogether credible that they wrote the Sagas and performed the voyages recorded. A corroboration of the Icelandic writings is also found in early English annals, which contain statements and dates that exactly agree. The manuscript from which the Sagas are taken is the Codex Flatöensis, "a work that was finished in 1395 at the latest, . . . and now preserved in the archives of Copenhagen."

The latter part of Dr. De Costa's work is devoted to translations from these writings, relative to the pre-Columbian voyages. Extracts are given from the Landanama, the doomsday-book of Iceland; from the Sagas of Eric, composed in Greenland; and from the Saga of Thorfinn, of Icelandic origin. Following these are minor narratives taken from the Eyrbyggia Saga, and two geographical fragments that mention Vinland. Although the volume possesses an index, it has the unusual distinction of being a book without chapters.

DUST AND ITS DANGERS. By T. MITCHELL PRUDDEN, M. D. New York: G. P. Putnam's Sons. Pp. 111. Price, 75 cents.

THE author of this book does not discuss purely inorganic dust of any sort, not even the specially injurious kinds resulting from processes of manufacture, but in a simple and attractive way tells of the common dust that is dangerous — that which contains micro-organisms hurtful to man. He describes the classes of germs that can be identified, and explains how biological analyses of the air are made by the "filtration" and the easier "plate method." Comparison of averages obtained in various cities and in different localities in New York show that the number of bacteria in a given volume of air varies chiefly according to condition, the process of street-cleaning summoning the greatest number of germs, 5,810 to a disk 3¼ inches in diameter. Indoor air is, however, the main subject of investigation, and experiments prove that ventilation which completely changes the atmosphere three times an hour will not appreciably affect the number of bacteria in an apartment, as the intruders cling obstinately to the carpets and upholstery. Only violent currents of air dislodge these, and the sweeping and cleansing which result in removing, not redistributing the dust. Ordinarily we are liable to take in with every twenty breaths from eleven to eight hundred and seventy-six organisms.

Among the disease-breeding bacteria Dr. Prudden selects for study the one numbering most victims, the *Bacillus tuberculosis*. He points out that prolonged drying does not kill it; that it does not exist in the air exhaled from consumptive lungs, but in the sputa that is ignorantly allowed to become part of the dust. It results that "the way to most efficiently stop this distinctly preventable disease is to see that the sputum of consumptives is properly disposed of."

One of the most instructive chapters is that in which the action of the cilia, of the lymph-filters, and of the wandering white cells, is described. A number of illustrations and an index accompany the book, which is published in uniform style with The Story of the Bacteria, by the same author.

RACES AND PEOPLES. By DANIEL G. BRINTON, M. D. New York: N. D. C. Hodges. Pp. 513. Price, $1.75.

A SERIES of lectures, delivered at the Academy of Natural Sciences, in Philadelphia, during the early months of 1890, forms the basis of this book. In the first two lectures are given respectively the physical and the mental characteristics of races, upon which ethnography is based. The third lect-

ure discusses the beginnings and subdivisions of races, locating the birthplace of the species in a region comprising southern Europe, the bed of the Mediterranean, and northern Africa, which in early Quaternary times was one connected body of land. In succeeding chapters the probable course of the early migrations of the various races, and the formation of subdivisions, are traced. The author places the first home of the white race—which he calls Eurafrican—in the region just mentioned, and regards its migrations as having taken place toward the east in two divisions. The early history of the black and yellow races, and of certain insular and littoral peoples, is then taken up. In his review of the American race, Dr. Brinton does not take up the question where the Indians came from, having stated fully elsewhere his reasons for believing that America was peopled from Europe, by way of a former land connection across the north Atlantic. A concluding lecture is devoted to discussing the destiny of races, and certain ethnographic problems, as acclimation, amalgamation, and civilization. An index of authors quoted and one of subjects are appended.

OUR GOVERNMENT: HOW IT GREW, WHAT IT DOES, AND HOW IT DOES IT. By JESSE MACY, A. M., Professor of Constitutional History and Political Economy in Iowa College. Revised edition. Boston: Ginn & Co. Pp. xii + 296.

PROF. MACY is to be congratulated on having produced in the work above mentioned an extremely valuable treatise upon the system of government under which we live. One of the encouraging signs of the times is the attention which is beginning to be bestowed in our schools and colleges upon the laws and institutions of the land—upon American politics in the wider and better sense. Foreigners are under a general impression that all American citizens able to read and write have the Constitution of their country at their fingers' ends, and that no one here needs much special preparation to enter on a political career. We could wish the impression had more foundation in truth than it has. The fact is, that ignorance in regard to the whole field of political knowledge is wide-spread among the electorate, and is in danger of becoming more so from year to year. The efforts, therefore, that are now being put forth to foster such knowledge are most timely; and we welcome the appearance of a manual like the present, which brings home to the mind of the student or general reader what kind of a country this is in a political sense; what the rights and duties of each citizen are, and what powers and responsibilities are invested in the different grades or species of government by law established. There are great advantages in a healthy and vigorous development of local institutions as with us; but, as everything good has some drawback, so this, on the whole, fortunate circumstance has the drawback of somewhat enfeebling the individual citizen's consciousness of participation in the life of the nation. We need to awaken and stimulate this consciousness, and the way to do it is undoubtedly to bring the facts of national life home to each mind by careful instruction. We do not hesitate to say that a knowledge of the facts contained in the work before us could scarcely fail to create in any ordinary mind a respectful interest in national and State politics, and would thus tend to rescue the individual citizen and voter from the hands of mere intriguing party managers. The amount of information in regard to local, municipal, State, and Federal Government that Prof. Macy has managed to pack into the present manual is surprising. There is not a single page which any student who desires to be thoroughly well informed in United States politics can afford to skip. Comparing the present work with Mr. Fiske's recent book, we may say that Prof. Macy's is the more complete hand-book of the two, while Mr. Fiske's is perhaps better adapted to bring home powerfully to the mind of the reader a limited number of carefully chosen facts and ideas. A valuable division of Prof. Macy's book is Part III, on The Administration of Justice, in which a large amount of information is given in regard to State and Federal courts and their respective jurisdictions and modes of procedure. The different departments of the Federal Government are well described in Part IV, as well as the methods followed by the two Houses of Congress in the dispatch of business. Part V deals particularly with Constitutions—chiefly, of course,

State and Federal. The idea that may be derived from the *résumé* of State Constitutions here given is that much might yet be done to bring some of these into a more rational and business-like form. We are strongly reminded how many things with us are yet in the experimental stage, and the thought is not very far in the background that much of our experimenting has been somewhat crudely done.

Prof. Macy has abstained from all criticism of institutions. Even in pointing out the differences between British cabinet government and the system established here, he does not venture on any hint as to which on the whole is the better, or as to which is the better even from any partial point of view. He does not hesitate, however, to condemn the "spoils system," giving in detail his reasons for regarding it as one of the plague-spots of our political life. We think that perhaps a few words more than he has actually given might have been devoted to the Civil-Service Bill at present in force; and it might not have been amiss to show how difficult both political parties seem to find it to carry out their pledges in favor of civil-service reform. Take it all in all, however, as a hand-book of the political institutions of the United States, Prof. Macy's little work is deserving of high praise for completeness, accuracy, and good sense. We hope it will come into wide use.

A MANUAL OF PUBLIC HEALTH. By A. WYNTER BLYTH, M. R. C. S., etc. London and New York: Macmillan & Co. Pp. 653. Price, $5.25.

THIS work is a comprehensive and authoritative text-book for officers of public health departments. Its first section, of three chapters, is devoted to vital statistics, giving methods of recording the data, and of calculating birth and death rates, life tables, etc., and describing certain calculating machines. The next section deals with air, ventilation, and warming, taking up the general character of air, with methods of analyzing it, the principles and methods of ventilating and warming, and including a chapter on measuring cubic space and reporting on ventilation. Two short chapters describe the common instruments used for meteorological observations. A section on water supply tells the usual sources of water, and gives microscopical, biological, and both qualitative and quantitative chemical processes for water analysis. There is also a chapter describing the supplies of the various companies furnishing water in the city of London. The section on sewerage describes the construction of house drains and of sewers, the arrangements for certain special systems of sewerage, and various methods for the disposal of sewage. The sewering of London is also described, with a map. Under the head of nuisances, the processes employed in a large number of manufactures yielding offensive waste products are given.

The section on disinfecting contains experimental methods for testing the value of a disinfectant, an account of various apparatuses for disinfection by heat and of the general process, and information concerning chemical disinfectants, giving especial prominence to the halogens. About two hundred pages are devoted to zymotic diseases, in which the modern general theory of microparasites is first given, and then the special character and course of each disease of this class. Single chapters deal with the construction of isolation hospitals, the general principles of diet, and the duties of sanitary officers as prescribed by English statutes. Inspection of food is the subject of the closing section, and this gives the characteristics of unfit vegetable and animal foods, and describes diseases of animals which make their flesh unwholesome. There are sixty-five cuts and plates, and an index.

ENGLISH FAIRY TALES. Collected by JOSEPH JACOBS, Editor of Folk-Lore. New York: G. P. Putnam's Sons. Pp. 253.

"WHO," the editor asks, "says that English folk have no fairy tales of their own? The present volume contains only a selection out of some one hundred and forty, of which I have found traces in this country [England]. It is probable that many more exist." A quarter of the tales in the volume have been collected during the last ten years or so, and some of them have not been hitherto published. The name Fairy Tales is given to the collection, though few of the stories speak of fairies. Yet they are what the little ones mean when they call for fairy tales. They do not call for "folk tales" or "nursery tales," and this is the only name we can give them. The term

fairy tales must be extended a little to include tales in which something "fairy," or extraordinary, like fairies, giants, dwarfs, or speaking animals, occurs; and also to cover tales in which the extraordinary thing is the stupidity of some of the actors. The question of nationality, too, is one to which it is hard to assign limits. Some of the stories were found among the descendants of English immigrants in America, some in Australia, some among the Lowland Scotch; and one of the best was taken down from the mouth of an English gypsy. Some of them exist in the form of ballads. Writing for children, the author has considered it expedient to take a few liberties with the text, translating sometimes from dialect or introducing or changing an incident; but mention of the fact is always made in the notes. He has felt authorized to do this amount of adaptation because he expects on some future occasion to treat the subject of the English folk-lore tale in a critical manner, when the originals will be reproduced with literal accuracy.

THE MYOLOGY OF THE RAVEN. By R. W. SHUFELDT. London and New York: Macmillan & Co. Pp. 343. Price, $4.

THE author has prepared this treatise in the belief that a work fully and practically illustrated and devoted to a complete account of the muscles of any species of bird is wanting; and that such a work would be of service to persons engaged in the general morphology of vertebrates as well as to special students. Birds are among the most easily procurable subjects for the use of the demonstrator and the student, and of these none are more convenient than those of the raven kind, which represent a numerous and cosmopolitan family, including the crows, jays, orioles, and very many others. As, according to the author, the student's investigations in the myology of birds advance, three lines of improvement in knowledge of their muscular system will force themselves upon him. "In the first place, we still remain very ignorant of the details of this system in a great many important types of birds; secondly, an ever-pressing demand is evident to fix the homologies of muscles in the vertebrata, and, consequently, to bring so far-reaching a knowledge of this department of research to our assistance as to be able to give the same name to the same muscles accurately throughout the vertebrate series; and, finally, a simple, scientific, and euphonious nomenclature is very much to be desired. As an index of our present status with respect to our knowledge of the muscles of birds, it is hoped that the volume here offered will faithfully represent it; but its writer trusts that in future works he may lend his assistance to the improvement of all the lines above indicated."

A PRACTICAL DELSARTE PRIMER. By Mrs. ANNA RANDALL-DIEHL. Syracuse, N. Y.: C. W. Bardeen. Pp. 66.

IF the only aim of this little book had been to serve as a guide in making the body flexible and responsive, one third of the contents might have been omitted with nothing to regret.

The first chapter suggests an excellent drill to gain bodily control. Exercises are given for the fingers, hands, shoulders, head, and trunk; also directions for various movements, including stage-falls. In the closing chapter it is shown how the acquired suppleness may be utilized in representing mental and emotional states. The laws of expression in relation to each organ are defined, and a quotation is made from Duchenne's Human Physiognomy, confirming the method delineated.

The intermediate part of the book is taken up with an outline of the philosophy of Delsarte, which is said to depend upon "the triune nature of man." A trinity is defined as "the union of three things necessarily coexistent in time, copenetrative in space, co-operative in motion." Accordingly, the human organization is split up into ternary combinations, and nothing is allowed to overflow the trinitarian mold. There is the "essential trinity" and the "dynamic trinity"; the "nervous," the "circulatory," and the "visceral trinity."

The triple classification into moral, mental, and vital, differentiates our unoffending members in a remarkable manner. The bones are vital, the skin mental, and the flesh moral. The pupil of the eye expresses intellect, but the iris has a leaning toward righteousness. The tip of the nose is also virtuously distinguished from the nostrils.

Why the epigastric organs should be moral while the thoracic are mental is another philosophic mystery.

Not less perplexing than this tripartition is the use made of the word thermometer. We learn that there are six physical thermometers—the larynx, wrist, shoulder, elbow, eyebrow, and thumb. The eyebrow is the thermometer of the mind, from which we might infer that Shakespeare wrote in all seriousness of "a woful ballad" to that important feature. However, judgment is declared to be "the lowest form of intellectuality," and in the dim light above it, or without it, little incongruities, such as have been noticed, may not appear.

In a sketch of François Delsarte, prefixed to this work, it is expressly stated that he died in 1871. Were it not for this, we might conclude that he flourished some seven hundred years earlier, and that we had stumbled upon a manual of the old scholastics, who tortured facts into accordance with arbitrary symbols and "ground the air in metaphysic mills."

ARE THE EFFECTS OF USE AND DISUSE INHERITED? By WILLIAM P. BALL. Nature Series. London and New York: Macmillan & Co. Pp. 156. Price, $1.

THIS is obviously and avowedly a controversial book. The author takes the negative side of his question, in opposition to Darwin and Spencer, and argues it with much ability and in an admirably courteous tone. He is not, however, alone in his position, for he is able to name Weismann, Wallace, Poulton, Ray Lankester, and Francis Galton as disagreeing in greater or less measure from the two great leaders just named. The author examines in detail the examples of Spencer and those of Darwin cited on the affirmative side of this question and replies to them. He next discusses the inheritance of injuries, and then passes to certain miscellaneous considerations. In conclusion, he affirms that use-inheritance is supported by insufficient evidence, while "the adverse facts and considerations are almost strong enough to prove the actual non-existence of such a law or tendency." But, he says, "It will be enough to ask that the Lamarckian factor of use-inheritance shall be removed from the category of accredited factors of evolution to that of unnecessary and improbable hypotheses. The main explanation or source of the fallacy may be found in the fact that natural selection frequently imitates some of the more obvious effects of use and disuse. . . . As depicted by its defenders, use-inheritance transmits evils far more powerfully and promptly than benefits." It is to natural selection, without the doubtful aid (as he deems it) of use-inheritance, that he trusts to save the race as a whole from degeneration.

ASTRONOMY: SUN, MOON, STARS, ETC. By WILLIAM DURHAM, F. R. S. E. Edinburgh: Adam & Charles Black. Pp. 138. Price, 50 cents.

THE character of this book is indicated by the name of the series in which it is the second volume—Science in Plain Language. The author states that it is not a treatise on astronomy, but that it "merely describes in plain language some of the more interesting facts and speculations connected with that science." The divisions of the subject which he makes are, the sun and moon; the earth; stars, nebulæ, etc.; planets; astronomical speculations as to the formation of the heavenly bodies, and the contents of space; the tides, etc. The various topics are treated in an attractive style, free from mathematics, but in such a way as to impart as full a knowledge of astronomy as most cultivated people require.

DERIVATION OF PRACTICAL ELECTRICAL UNITS. By Lieutenant F. B. BADT and Prof. H. S. CARHART. Chicago: Electrician Publishing Company. Pp. 56. Price, 75 cents.

How did certain electrical units come to be called ampère, ohm, farad, etc.? must have been asked by many persons, knowing more or less of electrical science. To answer this question is the task that Mr. Badt undertakes in the little volume before us. He gives in an introductory chapter the general reasons for adopting the system of practical units now in use, with a table showing the names and symbols of the several units, the quantity to be measured by each, comparative values, remarks, etc. This is followed by biographical sketches and portraits of the eminent electricians whose names have been given to these units. The list includes

Weber, Gauss, Ampère, Volta, Ohm, Faraday, Watt, Joule, Dr. Werner von Siemens, Sir William Siemens, Daniell, and Von Jacobi. A sketch of Coulomb is also given, without a portrait, and the author doubts if one is extant. In each sketch is told how and when the name of the subject was adopted for an electrical unit. A chapter by Prof. H. S. Carhart on Modifications of the Practical Electrical Units, is added, in which it is pointed out that, since there are three units of resistance in use, there are accordingly three modifications of all units depending upon this.

Psychological investigators will be interested in Prof. *Joseph Jastrow's* essay on *The Time-Relations of Mental Phenomena*, published in the series of Fact and Theory Papers (Hodges, 50 cents). The paper defines and analyzes simple and complex reactions, describes the methods of experimentation that have been devised by a number of investigators, and gives two tables—one of simple, the other of complex reaction times—from the observations of Cattell, Berger, Münsterberg, Kries and Auerbach, Merkel, and others. Various conditions affecting the times of simple reactions, and such as affect distinction, choice, association, and other elements of complex reactions, are discussed, and a classified bibliography is appended.

A little manual on *Maps and Map-Drawing*, by *William A. Elderton*, has been issued in Macmillan's Geographical Series (Macmillan, 35 cents). It describes briefly various modes of surveying, and tells some of the things that can be learned from globes—among them the explanation of great-circle sailing. In the chapter on map-drawing the several projections are described; contouring, hachuring, and mezzotint shading are taken up; and a few directions for the use of maps are given. A short chapter on copying maps is included; but the author does not deem this as important as the drawing of memory maps. The latter subject he, accordingly, treats more fully, giving directions for drawing a memory map roughly, taking France as an example; also for doing more careful work, using England and Wales as the subject; and for a rough map of the world on Mercator's projection.

An address on *The Future of Agriculture in the United States*, by Dr. *Peter Collier*, of the New York Agricultural Experiment Station, is devoted to the exhortation of farmers to study and put more intelligence into their work, and to the enforcement of the thesis that "we have not yet begun to approach the limit of even profitable production upon our lands."

A new monthly periodical, called the *Educational Review*, is to be begun in January, to be published by Henry Holt & Co. Prof. *Nicholas Murray Butler*, of Columbia College, President of the New York College for the Training of Teachers, will be its editor, and will have as his associates head-master E. H. Cook, of Rutgers Preparatory School, New Brunswick, N. J.; Dr. William H. Maxwell and Dr. A. B. Poland, superintendents of schools in Brooklyn and in Jersey City. The University, the Preparatory School, and the public schools will thus be represented in its editing. The enterprise starts with the approval, attached to its prospectus, of some hundred leading educators.

Poet Lore, a monthly magazine, devoted to Shakespeare, Browning, and the comparative study of literature (Poet Lore Co, 1602 Chestnut Street, Philadelphia), *Charlotte Porter* and *Helen A. Clarke*, editors, is a literary periodical of the highest order. Besides the two authors specially named, recent numbers have contained studies of the Provençal poets, by Miss M. L. Elmendorf; English and German Literature in the Eighteenth Century, by Prof. Oswald Leidensticker; Shelley; the Alkestis; Dante; The Russian Drama, by Nathan Haskel Dole; and other papers, which define the scope of the publication as a sufficiently broad one to make it acceptable to all cultivated readers. The November number contains a study of Browning's "Childe Roland." Next year, in lieu of the July and August numbers, double numbers will be published in June and September, each containing a foreign work of the first order, little known, but destined to awaken strong interest. The contents will be increasingly in the direction of comparative criticism. Price, 25 cents a number; $2.50 a year.

G. P. Putnam's Sons publish, in the Story of the Nations Series, *Switzerland*, prepared

by Lina Hug and Richard Stead. Due stress is laid upon the interest of the story, which is attractive to American readers by its association with the other features of the country—"the playground of Europe"—as well as by the long, arduous, and faithful struggles for liberty which it records. Most of the existing accounts of Swiss history in the English language go no further back than A. D. 1291, the date of the earliest Swiss league, and of the beginning of modern Swiss nationality. The authors in the present volume have gone beyond this, and have included the previous history of the men who founded the league, with the changes which the country has undergone, in being overrun by different barbarous tribes; accounts of Cæsar's Helvetians; and of the lake-dwellers. The lesson of the history of the country is enforced by the citation of the maxim that "it teaches us, all the way through, that Swiss liberty has been won by a close union of many small states."

Biblia, a monthly magazine devoted to biblical archæology, furnishes a current record of what is accomplished in the survey and exploration, particularly of the monuments, of the extremely ancient centers of civilization, gives reviews of literature on the subject, and assists the purposes of the Palestine and Egypt exploration funds and other societies engaged in Oriental investigation. The subscription price is one dollar a year. The publication office for New York is with B. Westermann & Co.

The third of the Manuals of Religious Instruction, Doctrinal Series, published by the New Church Board of Publication, is a series of *Descriptions of the Spiritual World*, for use with children, from the writings of *Emanuel Swedenborg*. The works chiefly represented are the Heaven and Hell, Conjugal Love, and the True Christian Religion.

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Bissell, Mary Taylor, M. D. Household Hygiene. New York: N. D. C. Hodges. Pp. 88. 75 cents.

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POPULAR MISCELLANY.

Pasteur Institute, New York.—From the opening of the New York Pasteur Institute, February 18, 1890, till October 15th, 610 persons that had been bitten by dogs or cats presented themselves to be treated. For 480 of these patients it was demonstrated that the animals which attacked them were not mad. Consequently, they were sent back, after having had their wounds attended during the proper length of time when it was necessary; 400 patients of this series were consulted or treated gratis. In 130 cases the antihydrophobic treatment was applied, hydrophobia having been demonstrated by veterinary examination of the animals which inflicted bites, or by the inoculation in the laboratory, and in many cases by the death of some other persons or animals bitten by the same dogs. All these persons were, on the day of the report, enjoying good health. In eighty cases the patients received the treatment free of charge. The persons treated were—sixty-four from New York; twelve from New Jersey; twelve from Massachusetts; eight from Connecticut; nine from Illinois; three from Missouri; three from North Carolina; three from Pennsylvania; two from New Hampshire; two from Georgia; two from Texas; one from Maryland; one from Maine; one from Kentucky; one from Ohio; one from Arizona; one from Iowa; one from Nebraska; one from Arkansas; one from Louisiana; and one from Ontario, Canada.

The Tuscarora Deep.—Rear-Admiral Belknap, of the United States Navy, read a paper before the Asiatic Society of Japan in Yokohama, in October, describing the deep soundings made by his survey vessel, the Tuscarora, in the Kuro Siwo, last summer, and comparing them with deep soundings in other seas and parts of the ocean. The main object of the Tuscarora expedition was to determine the feasibility of a cable route across the mid-North-Pacific from California to Yokohoma, by way of Honolulu and the Bonin Islands, and on the homeward run to survey a second route from a point on the east coast of Japan, on a great circle running through the Aleutian chain of islands, and ending at Cape Flattery at the entrance of Puget Sound. The mid-Pacific survey had been successfully run, without finding any unusually remarkable depths, and the party anticipated that the return survey would be correspondingly easy. But, putting to sea on the 10th of June, the Tuscarora had hardly got a hundred miles from the coast, when a sounding was made of 3,427 fathoms, the waters having deepened more than 1,800 fathoms in a run of thirty miles. The next cast was still more startling, for, when 4,643 fathoms of wire had run out, it broke without bottom having been reached. Corresponding depths to these were found in all the sound-

ings taken in that neighborhood, the greatest measured being 4,655 fathoms. At 4,340 fathoms a Miller Casella thermometer came up wrecked from the resultant pressure. The time occupied in making a cast of 4,356 fathoms and getting back a specimen of the bottom was two hours twenty-six minutes and fifty-seven seconds. Good specimens were brought up from four of the depths, and in one other the specimen-cup struck rock. At the deepest of the casts the wire parted. In view of the remarkable depths found, the conclusion was irresistible that the great-circle route would have to be abandoned, and a new line of less depth adopted if it could be found. This series of depths, ranging from 3,500 fathoms to 4,600 fathoms and upward south and east of the ridge between Cape Lopatka and the Aleutian Islands, indicates that a trough or basin of extraordinary depth and extent exists along the east coast of Japan and the Kurile Islands and under the Black Stream (Kuro Siwo), exceeding any similar depression yet found in any other region of the great oceans. The depth of the deepest cast —five miles and a quarter, the deepest water yet found—is sufficient to hold two mountains as high as Japan's great Fusi-jama, and leave them nearly two thirds of a mile under water. This region of the Pacific has been named by the German geographer Petermann the "Tuscarora Deep."

Improvement of Printing-machines.—The first automatic printing-machines, according to Messrs. Southward and Wilson's work on the subject, were invented for calico-printing in 1750. About a hundred years ago, Nicholson took out a patent for a machine applicable to the printing-press. It did not come into use, on account of Nicholson's poverty, and the first practical machine was made by Koenig in 1810, when the Annual Register was printed on his press. This machine was capable of printing a thousand copies in an hour, while no other press then existing could print more than a fourth of that number. Curved stereotype plates were made by Cowper in 1816. Inking by rollers had already been invented. For the last sixty years progress has been very rapid, and every year brings some new machine to save time and trouble, and increase the speed of production. Much attention is now given to type-setting machines, of which six are described by Southward and Wilson as in use. The great difficulty in the use of these machines, which has only now been solved, is in the distribution of the type. It is evaded in the London Times office by taking a cast of the matter, then melting the type and refounding it. One of the latest machines, it is said, however, effects the distribution as rapidly as the setting.

The Aye-aye.—A curious creature is the aye-aye (*Cheiromys madagascariensis*), which was long a puzzle to naturalists on account of its many peculiarities of form and structure. It was named by the French traveler Sonnerat, after an exclamation made by the Malagasy natives on seeing it. It is classified by Prof. Owen as the sole representative of the last of the three families into which the lemuroids are divided. It has eighteen teeth, of which the four front ones—two upper and two lower—are much like those of a rat. Cuvier compared the lower teeth to plowshares. They are powerful cutting instruments, and available for removing wood, making holes in branches, and gnawing through the stems of sugar-canes and other similar plants. The ears are large, round, and open, and have been compared to those of a bat; the eyes are wide and staring; and the upper lip is perfect, or uncleft. The whole body, except the ears, nose, soles, and palms, is covered with thick, dark fur. The most curious peculiarity of the animal lies in the structure of the third and fourth fingers, which are very long, the fourth being the largest and longest, while the third is so extraordinarily thin and wasted in appearance that, as Prof. Owen says, it seems as if it was paralyzed. The use of this finger is described by Prof. Sandwith, who gave his pet aye-aye some sticks to gnaw which were bored by grubs: "Presently he came to one of the worm-eaten branches, which he began to examine most attentively, and, bending forward his ears and applying his nose more closely to the bark, he rapidly tapped the surface with the curious second digit as a woodpecker taps a tree, though with much less noise,

from time to time inserting the end of the slender finger into the worm-holes as a surgeon would a probe. At length he came to a part of the branch which evidently gave out an interesting sound, for he began to tear it with his strong teeth. He rapidly stripped off the bark, cut into the wood, and exposed the nest of a grub, which he daintily picked out of its bed with the slender tapping finger and conveyed the luscious morsel to his mouth." The aye-aye is nocturnal, and seldom lets itself be seen in the daytime.

Montezuma's Head-dress.—A study was recently published by Mrs. Zelia Nuttall of a rare object in the Imperial Ambras Collection at Vienna which has been variously described as a Mexican head-dress, a garment intended to be worn about the waist as an apron, and a standard. Whatever it may have been, it was supposed to have belonged to some person attached to the court of Montezuma. The author decides that it was a head-dress. As it is now mounted, on a backing of black velvet, it presents a gorgeous appearance. The long, loose fringe of quetzal-feathers exhibits slight evidence of decay, while the other parts have been carefully restored. The fan-shaped base of the feather-piece is composed of harmoniously disposed concentric bands of delicate feather-work studded with thin beaten gold plates of different shapes. The details of the structure and attachment of these plates confirm what the early Spaniards said about the admirable nicety of Mexican industrial art. The loose fringe was composed of about five hundred of the long tail-feathers, of which each male quetzal bird has but two. Next to it the most striking feature of the specimen is the broad turquoise-blue band of feathers on which a design was executed with small gold pieces, originally fourteen hundred in number, disposed, overlapping one another like fish-scales, so as to form a flexible rectilinear pattern suggesting a series of small towers. The blue of this band was edged with a band of scarlet feathers, so disposed that their inner sides, curling outward, formed a projecting ruffled border. Above this were fringes of the small wing-feathers of the quetzal and of the tail-feathers of the cuckoo, whose white tips formed a sharply defined broad line studded with small gold disks. The whole was skillfully worked upon a suitable backing, and secured by a kind of kite-frame. "Manufactured with the utmost care," says Mrs. Nuttall, "of materials most highly esteemed by the Mexicans, uniting the attribute and emblematic color of Huitzilopochotli, fashioned in a shape exclusively used by the hero-god's living representatives, the high priest and the war chief, this head-dress could have been appropriately owned and disposed of by Montezuma alone at the time of the conquest, from which period it assuredly dates." It was probably one of the gifts sent to the Emperor Charles V by Cortes in 1519.

Influenza and the Weather.—A study of the relations of weather and influenza, so far as they may be illustrated by the registrar-general's reports for London from 1875 to 1890, has been published by Sir Arthur Mitchell and Dr. Buchan. The recurrence of a strongly marked winter maximum and an equally marked summer minimum through the whole forty-five years, with a small secondary maximum running from the middle of March to the middle of April, indicate that the rate of deaths from influenza is inverse to the temperature. The curve showing their distribution is congruent with that for diseases of the breathing organs, with the addition of a slight rise in the spring. But although the epidemics occurred mostly during the cold season, they were not connected with any exceptionally cold weather at that season, but rather with exceptionally warm weather, which manifested itself generally both before and during the epidemic. In no case was any exceptionally cold weather, intercalated in the period of the epidemic, accompanied with an increase of deaths from influenza, or even with an arresting of the downward course of the curve of mortality, if the cold occurred at the time the epidemic was on the wane. Other diseases which appear to have prevailed most extensively during epidemics of influenza are diseases of the breathing organs, phthisis, diseases of the circulatory system, rheumatism, and diseases of the nervous system. The diseases which yielded a mortality un-

der the average during the prevalence of the epidemic were diarrhœa and dysentery, liver disease, measles, scarlet fever, typhoid fever, and erysipelas. The death-rate of persons above twenty years old rose considerably above the average during the four or five weeks immediately preceding the beginning of the registration of deaths due to the epidemic. In studying the dissemination of germs of the disease by winds, it is well not to confine attention to surface winds. It is now found that atmospheric circulation takes place largely through cyclones and anticyclones, by means of which the levels of the currents are changed.

Zigzag Lightning.—It was asserted by Mr Shelford Bidwell, in a lecture at the London Institution, that the zigzag lightning-flash of artists has no existence in nature, but is simply an artistic fiction or symbol; and the speaker produced photographs to prove his point, asserting that not an instance of the zigzag flash could be found among the two hundred specimens in the collection of the Meteorological Society. Mr. Eric S. Bruce has since published a paper for the purpose of showing how the zigzag flash, which is really often seen by observers and is frequently depicted by artists, may have a counterpart in nature consistent with the evidence of the society's photographs. In his view, the appearance is not the flash itself, but is the optically projected image of the flash formed on clouds, not of a smooth surface, but of the rocky cumulus type. The image of the flash takes the angles of the uneven surface and becomes zigzagged. The author has exemplified this process by casting the photograph of a lightning-flash, by means of the optical lantern, on model cumulus clouds, when the "streaming" flash became zigzagged.

Identification by Measure.—M. Jacques Bertillon has described a method now practiced in France of identifying criminals by comparing their measures. Photography is used in it only as an aid to identification established by other means. The basis of the system is to obtain measurements of those bony parts of the body which undergo little or no change after maturity, and can be measured with extreme accuracy to within a very minute figure. Those parts are the head, foot, middle finger, and parts of them, and the extended forearm from the elbow. By the classification of these anthropometrical coefficients, a list including any number of persons of whom photographs are obtained can be divided into many groups containing a small number of individuals each. Stress is laid on the importance of the hand and the ear as marks of recognition. The hand, because it is the organ in most constant use in every calling, and in many trades and professions it becomes modified in accordance with the particular character of the work which it has to do. The ear is the precise opposite to this. It changes very slightly, if at all, except perhaps in the case of prize-fighters, who develop a peculiarity which is easily recognized. It is, therefore, an important organ to measure, inasmuch as the results are not likely to be nullified by a change in the conformation.

Irish Myths.—In his book on the Myths and Folk-lore of Ireland Mr. Jeremiah Curtin regards as insufficient the theories of Mr. Müller and Mr. Spencer, who derive all mythology from a misconception of the meanings of words and a confusion of ideas, and refers its origin to a misconception of the causes of phenomena. "The personages of any given body of myths," he says, "are such manifestations of force in the world around them, or the result of such manifestations, as the ancient myth-makers observed." Mr. James Mooney remarks that the definiteness of detail characteristic of Irish stories contrasts strongly with what is found in other parts of Europe. In Hungary, for instance, the usual introduction is, "There was in the world"; while the Russian story-teller, hardly more satisfactory, informs us that "in a certain state in a certain kingdom there was a man." In the Irish myths, on the contrary, according to Mr. Curtin, we are told who the characters are, what their condition of life is, and how they lived and acted; the heroes and their fields of action are brought before us with as much definiteness as if they were persons of to-day or yesterday. The Gaelic mythology, so far as it is preserved in Ireland, is said to be better preserved than the mythology of any other European country.

From the definite character of the myths, together with the internal evidence afforded by the language itself, it would seem that the Gaelic occupancy of Ireland dates from a very remote antiquity—going back, in fact, to the period of the earliest wave of migration from the primitive home of the Aryans.

Curiosities of African Custom.—Yet new phases of African life and custom are described in the diary of a journey from Bihe to the Bakuba country of the eminent Portuguese trader, Silva Porto. The Kiboko or Kashoko, when their chief dies, either return to their relatives or build themselves a new village. The new chief also builds a new village, and receives a man or a woman from each of his sub-chiefs as a contribution toward peopling it. The *lukano*, or bracelet, bestowed as a symbol of power upon one of the chiefs by his superior for faithful service, is made of brass or copper, interwoven with the sinews of a human being who has been sacrificed on some specially solemn occasion. It is covered with the skin of an antelope, and has charms attached to it. If the holder of this emblem loses the favor of his feudal lord, a messenger, bearing a similar bracelet, but of smaller size, and a two-edged knife, is sent to him, and the disgraced chief—and his brothers and wives usually with him—quietly submits to decapitation. A curious custom, called *shikayandando*, is observed by the Bakuba in concluding a bargain. An offer having been made and accepted, the vender plucks a leaf and presents it to the intending purchaser, who taking hold of it cuts it asunder, when the two pieces are thrown behind. If this mode of confirming a bargain is neglected, the vender can claim double the value of the merchandise in question.

Preservation of Mummies.—A supposition that the mummies of the Egyptian kings in the Archæological Museum at Ghizeh had begun to decay since they were unrolled and deprived of their bituminous coverings was suggested by the appearance of a white efflorescence on certain parts of the mummy of Seti I. In order to ascertain whether this was true, Dr. Fouquet, a person having special qualifications for the work, was invited by M. Grebaut to examine the mummies and the efflorescence, and determine whether signs of decay had been developed since the unrolling; whether the efflorescence was the result of damp, and whether the mummies were threatened with destruction. Dr. Fouquet reported that he had observed the efflorescence on the mummy of Seti I at the time it was unbandaged, June 16, 1886; that a specimen of it examined microscopically was found to be composed of scales and prisms of crystallized salts, with the origin of which dampness had nothing to do, and that in it were neither mycites nor spores; and that efforts to propagate mold on pieces of mummy and mummy-cloth exposed to damp resulted only in sterility. The efflorescence is, in fact, simply an extrusion of the salts employed in the embalming of the mummy, and of the repairs to the same when it was removed, about twenty-three hundred years ago, from its original resting-place to Dahr-el-Bahari. Hence, the mummies are supposed to be safe from atmospheric deterioration.

The Fijians.—In a lecture on the Fiji Islands, delivered at Hokitika, New Zealand, the Rev. S. J. Gibson said that the native population was about a hundred thousand, while the Europeans numbered three hundred thousand. All the natives have embraced Christianity; churches and schools are found in every village, and crime is almost unknown. In the construction of the native houses, chimneys and partitions are not appreciated. The sleeping-place is divided off by mosquito-curtains only. The men are powerful, well developed, with copper-colored skins, and some of the women are of prepossessing appearance. European clothing is used by some of the natives, and gives them occasionally a grotesque appearance. Oiling the body and liming the hair are customary. A dress consisting of a white shirt, a length of white sheeting round the waist, and a sash of native cloth is becoming. Young girls wear a waist-cloth and a sort of pinafore, without either head-covering or boots. The language is musical, but difficult to master; and it is, indeed, almost impossible for a white man to learn it thoroughly. A kind of bread is made by burying fruit with some substance to make

it ferment. After a time it is dug up and eaten; but the smell is rather strong at first. Fiji is a commonwealth in the proper sense of the term, all articles being public property. No native lives by trade, and they seem to have no idea of the principles of commerce. They are industrious, and adepts in pottery and wood-work, although their implements are for the most part crude. The native drum, formerly used to sound the war alarm, is now employed to summon people to church, which they all attend.

Ocean Transportation of Plant Species.—Experiments performed by Dr. Guppy at the Keeling Islands, which are six or seven hundred miles from the nearest large land, show that certain kinds of seeds will germinate freely after being thirty, forty, or fifty days in sea-water. During this time they may be conveyed, on a drift current of only one knot an hour, a distance of from one thousand to twelve hundred miles. Some seeds that do not readily float, or float only for short periods, are conveyed hither and thither in a variety of ways—as in the cavities of pumice-stone, and in the crevices of drift-wood. Such seeds as germinate have difficulties in establishing themselves, the most formidable of which are caused by the crabs, which eat the green sprouts as soon as they appear. If the plants escape the crabs in their earliest infancy, they are safe. An evidence of the tenacity of life under unfavorable conditions is afforded by the fact that despite clearing and cultivation, and the introduction of foreign enemies, no species of plant ever known to grow wild on the little islands has become quite extinct.

The Wise Use of Medals.—More discrimination in awarding medals by learned societies is recommended by Prof. W. M. Williams. "Looking critically," he says, "at the awards that have been made during the present generation, it is difficult to find a case in which the honor has not been fairly earned; but still, I think, they have not been as beneficially awarded as they might have been, nor in the manner generally desired by their founders. Most of them were intended as a stimulant, encouragement, and help to scientific workers. Such a medal would be all these to a poor or young or obscure worker, but is none of them to a man whose reputation is established, whose scientific eminence is already attained, and who is already quite sufficiently official." A case in point is that of J. A. R. Newlands, whose duly published discovery in 1864 and 1865 of the periodic law of the chemical elements was not noticed, while the Royal Society's Davy medal for the same discovery was given four or five years afterward to the "official" chemists Mendeleef and Lothar Meyer. But at length, in November last, Newlands received the medal which he had earned previous to either of the other chemists.

Leonardo da Vinci's Theory of Fossils.—M. Charles Revaisson is publishing phototypic *fac-similes* of the manuscripts of Leonardo da Vinci. It seems that nothing which constituted the scientific domain of mankind in the sixteenth century was strange to that illustrious artist. We give here his theory of the formation of fossils: "Of animals which have bones on the outside, such as shell-fish, snails, and oysters, of innumerable species.—When the floods of turbid rivers discharge fine mud on the animals living in the adjoining waters of the seashore, the animals remain pressed in the mud, and, being overwhelmed by its weight, necessarily die for want of the creatures on which they are accustomed to feed. The sea receding in time, this mud, the salt water having run off from it, becomes changed into stone, and the shells are filled with sand instead of the animals that have decayed from within them. Thus, in the midst of the transformation of all the surrounding mud into stone, that also which remained within the shells becomes joined by means of a slight opening of the shells with the other mud; so that all the shells are inclosed within the stone—that is, the stone that includes them and that which they contain. These shells are found in many places; and nearly all the petrified mollusks in the rocks of the mountains still have their natural shells—particularly those which had grown old enough to be preserved by their hardness; and the young, being already for the most part reduced to lime, had been penetrated by the viscous and petrifiable humor.

"Of the bones of fish which are found in the petrified fishes.—All animals having bones within their skin which have been covered by the mud of rivers, which have overflowed their ordinary beds, have received to the line the impress of that mud. And with time, the beds of the rivers having fallen, these animals having the impression of the mud which has inclosed them and consumed their flesh and organs, the bones alone remaining—their organization being consumed—they have fallen to the bottom of the concavity of their impression; and in that concavity the mud, when it has been dried by its elevation above the course of the river from its aqueous moisture and then from its viscous moisture, becomes stone, inclosing within itself whatever it finds there and filling everything hollow with itself. And finding the concavity of the impression of such animals, it penetrates subtilely into the minute porosities of the earth by which the air which was in them escapes—that is, by the lateral parts, for it can not escape above, because that porosity is occupied by the humor that descends into the void; and it can not flee below, because the humor already fallen has closed the porosity. There remain the lateral particles opened so that the air condensed and pressed by the humor that descends escapes with the same slowness with which the humor descends. That humor drying becomes stone without weight, and maintains the same form as the animals that have left their impression there, and of which it incloses the bones.

The Taxation of Revolvers.—The following, from the London Lancet, will apply with equal force in this country, where, in not a few cases, the boys even indulge in the senseless and dangerous practice of carrying fire-arms: "The dangerous folly of carrying revolvers was once more illustrated in a case recently tried in the North London Police Court. In this instance a young man, described as being most respectably connected, though without occupation, was accused of threatening to shoot a policeman with whom he had had an altercation. Though he had been drinking, he was not intoxicated. A revolver loaded in two chambers was taken from him. The case is exactly typical of its kind, and requires no further explanation to show the hazard and the uselessness of this custom of habitually carrying fire-arms. Entirely needless for purposes of self-defense, they may become at any angry moment the instruments of hasty and irreparable crime. Another minute and the policeman might have been a corpse and his assailant a foredoomed murderer, all for the sake of a petty difference of opinion. Most persons, we feel sure, will agree with us that the time is overdue for some restrictive measure which will abate this growing nuisance. We would, therefore, advocate once more the imposition of a sufficiently heavy tax upon the possession of these weapons, and of registration in each case of sale. To regulate by such restraints an idle practice and a constant menace to public security implies no injury to, but rather a needful care for, private rights."

The Pamir Table-land.—The name Pamir is not properly the name of any particular spot, but means the country of frozen winds. It is well fitted to the region to which it is applied—a table-land in central Asia, having the height of the Jungfrau, one of the highest of the Alps, and a superficial extent of a hundred thousand square kilometres. In consequence of its height, although it lies in the latitudes of southern Spain, its climate is extremely rigorous. The snow-line varies somewhat, at a height of about fifteen thousand feet, and the zone of cultivation rises to within about fifteen hundred feet of it. Within this zone cereals are raised, and a few good pasture tracts are found here and there. Forest growths are wanting.

About Certain Dye-stuffs.—The principal dye-woods of the Argentine Republic are the *Quebracho colorado*, the *Algorrobo blanco*, the *Corovillo*, and the *Lapacho*. The extract of the quebracho, the chemical constitution of which has not been ascertained, when dried, gives an almost black substance, brittle, and having a characteristic luster. It is used alone to dye wool, and with mordants. The brownish-black sap of the algorrobo gradually solidifies in the air into a resinous and gummy substance that wholly

dissolves in water, or into delicate, viscous, and somewhat tough superficial laminæ. Without using any mordant, it produces very fast colors in wool, silk, cotton, and linen goods, varying, according to the application, from the clearest to the blackest brown. The corovillo affords a deep scarlet color, the preparation and application of which are a secret known only to a few families who keep it well. The acid extract from the lapacho—lapachic acid—appearing in greenish-yellow needle-crystals, affords, according to its treatment, rose-crimson, yellow, clear brown, and dark brown. The tree itself has some remarkable characteristics—in the impenetrable density of its inflorescence previous to the appearance of the leaves, the firmness and strength of its wood and its freedom from ash, the resistance of the wood to decay, and the intense induration of its wood when soaked for a considerable time in water.

Speed of Insects.—"Flies," observes a writer in the London Spectator, "frequent the insides of our windows, buzzing sluggishly in and out of the room. But what different creatures are they when they accompany your horse on a hot summer's day! A swarm of these little pests keep pertinaciously on wing about your horse's ears; quicken the pace up to ten or twelve miles an hour, still they are there; let a gust of wind arise and carry them backward and behind, the breeze having dropped, their speed is redoubled, and they return to their post of annoyance to the poor horse. But this example gives only a partial proof of the fly's power of flight. The present writer was traveling one day in autumn by rail at about twenty-five miles an hour, when a company of flies put in an appearance at the carriage-window. They never settled, but easily kept pace with the train; so much so, indeed, that their flight seemed to be almost mechanical, and a thought struck the writer that they had probably been drawn into a kind of vortex, whereby they were drawn onward with little exertion on the part of themselves. But this notion was soon disproved. They sallied forth at right angles from the carriage, flew to a distance of thirty or forty feet, still keeping pace, and then returned with increased speed and buoyancy to the window." The same writer estimates that the dragon-fly, which passes and repasses as in instantaneous jerks, is capable of flying at a speed of from eighty to a hundred miles an hour.

Ambergris. — The word ambergris is French for gray amber, which is a misnomer, for ambergris is a very different substance from amber. The latter is fossilized resin, and is therefore of vegetable origin, while the former is a product of some disease in the sperm whale. Ambergris is sometimes found in the intestines of the whale, but most of the supply is picked up in masses which float on the surface of tropical seas. The best ambergris is soft and waxy, gray in color, and streaked with different shades. It is opaque, inflammable, and remarkably light. It is found in the largest quantities near the Bahamas, but it is a scarce article at best, being quoted in New York at thirty-four dollars an ounce, wholesale. Its use is in perfumery, its great value being due to its powerful odor, which somewhat resembles that of musk, but is much more lasting. It is so peculiar that it has never been successfully imitated. Ambergris is so costly that it is one of the most adulterated articles known in commerce. It is too costly to use alone, but a small quantity of its solution in alcohol is mixed with other perfumes, the blended odor of which it intensifies. A grain or two rubbed down with sugar is often added to a hogshead of wine, to which it gives a pleasing fragrance. A handkerchief perfumed with the famous Parisian compound perfume, *extrait d'ambre*, will retain the odor after several washings.

Strength of the Earth's Crust.—In estimating the strength of the earth's crust, Mr. G. K. Gilbert uses the term crust to indicate the outside part of the earth, without reference to the question whether it differs in constitution from the interior. The conditions of the problem are illustrated by supposing a large tank of paraffin with level surface. If a hole be dug in this and the material piled up at one side, the permanence of the hole or heap will depend on its magnitude. Beyond a certain limit, further excavation and heaping will be compensated by the flow of the material. Substitute for

paraffin the material of the earth's crust and the same result will follow, but the limitations of the hole or heap will be different, because the strength of the materials is not the same. Assuming the earth to be homogeneous, the greatest possible stable prominence or depression is a measure of the strength of the material. Having examined a marked example of elevation and depression in the region of the Pleistocene Lake Bonneville and the Wahsatch Mountains, the author deduces the working hypotheses that the measure of the strength of the crust is a prominence or cavity about six hundred cubic miles in volume; and that mountains, mountain ranges, and valleys of magnitude equivalent to mountains, exist generally in virtue of the rigidity of the earth's crust; continents, continental plateaus, and oceanic basins exist generally in virtue of isostatic equilibrium in a crust heterogeneous as to density.

The Dragon-fly and the Cricket.—Mr. E. Giles relates, in the Journal of the Bombay Natural History Society, that in June, 1888, his attention was attracted by a large dragon-fly which was cruising backward and forward in his porch in an earnest manner that seemed to show that he had some special object in view. Suddenly he alighted at a small hole in the gravel and began to dig vigorously, sending the dust in small showers behind him. "I watched him," says Mr. Giles, "with great attention, and after the lapse of about half a minute, when the dragon-fly was head and shoulders down the hole, a large and very fat cricket emerged like a bolted rabbit, and sprang several feet into the air. Then ensued a brisk contest of bounds and darts, the cricket springing from side to side and up and down, and the dragon-fly darting at him the moment he alighted. It was long odds on the dragon-fly, for the cricket was too fat to last, and his springs became slower and slower, till at last his enemy succeeded in pinning him by the neck. The dragon-fly seemed to bite the cricket, who, after a struggle or two, turned over on his back and lay motionless, either dead or temporarily senseless. The dragon-fly then, without any hesitation, seized him by the hind legs, dragged him rapidly to the hole out of which he had dug him, entered himself and pulled the cricket in after him, and then, emerging, scratched some sand over the hole and flew away. Time for the whole transaction, say, three minutes."

Evolution in Floridian Shells.—Except Mr. Edward Potts's article on Fresh-water Sponges collected in Florida, all the papers in Vol. II (December, 1889) of the Transactions of the Wagner Free Institute of Science of Philadelphia are by Prof. Joseph Leidy. They are on Some Fossil Human Bones; Mammalian Remains from a Rock Crevice in Florida; Mammalian Remains from the Salt Mine of Petite Anse, Louisiana; Platygonus, an Extinct Genus allied to the Peccaries; and The Nature of Organic Species. The last paper relates to a series of shells found in Florida which appear to illustrate the transmission or evolution of an extinct form (*Fulgur contrarius*) into that of a living species (*Fulgur perversus*). The changes are illustrated by engraved plates. In this series, as also in a series of *Strombus*, great variability seems to have prevailed among the fossil forms, while the existing species are comparatively stable. Another shell, the *Melongena coronata*, found in the same bed, manifests great uniformity in structure; "while, at the present time, it is probably the most variable shell living on the coast of Florida. . . . We thus find in the same bed one genus that was widely variable in character which now manifests much greater stability in structure; and also two genera that were quite fixed or stable that at the present time are very inconstant." In explanation of this anomaly Prof. Leidy suggests that "no species has been found to be constant or permanent during a long period of geological time; and there appear to have been periods of rest and periods of activity in the transmutation of species. Surviving from the Miocene age, the *Fulgur contrarius* may have been ripe for a change, which was stimulated into action by a cause that would not affect other species, especially such as had not been in existence long. For the same reason the *Melongena coronata* and the *Strombus pugilis* may be active in their inconstancy now, as they have survived from a former period."

Ancient Maps of the Egyptian Desert.—Mr. Cope Whitehouse called attention, in the British Association, to some points in connection with ancient maps of Egypt, Lake Mœris, and the Mountains of the Moon. The revised map of Egypt prepared by the Intelligence Department of the War Office shows a part of the changes effected by the observations of the author. A critical study of the manuscript and printed maps attached to the text of Claudius Ptolemy had enabled him to aver, as a crucial test of their authenticity, that a depression would be found to exist in the desert to the west of the Nile and to the south of the Fayoum. The physical conditions of this region have now been determined with extreme accuracy. The most important maps of the printed editions of Claudius Ptolemy, of the sixteenth and seventeenth centuries, have been reproduced in the *fac-simile* atlas of 1890. Mr. H. M. Stanley's identifications of Ruwenzori with the Mountains of the Moon reversed this method. He found the mountains and then examined the maps and the historical evidence. The existence of ancient originals from which the mediæval copies were made is no longer open to dispute. They have never been submitted to critical analysis. It is reasonable to anticipate other important additions to geographical knowledge as the result of the renewed credit which will henceforth attach to the only atlas which has reached us from ancient days.

NOTES.

In reference to a note in the Monthly for December, 1890, ascribing to Dr. Charles M. Cresson the discovery of typhoid bacillus in juices squeezed from celery, Dr. Cresson desires to observe that the only publication he has made in reference to the bacillus of typhoid in connection with celery, bore upon the practice of certain truck-farmers of ladling upon the plants, for manure, untreated night-soil directly from the carts. Some of the stuff is certain to lodge in the interstices of the plant and not be washed off, and that may contain typhoid bacilli. No claim has been made or facts given that would warrant the assertion that the bacillus was naturally carried in the juice of the plant.

Prof. Pickering describes, in the Sidereal Messenger, fourteen photographs of the planet Mars, which were taken on two successive days, the 9th and 10th of April, seven on each day, in the second of which the southern polar white spot was much larger than in the former series. In the first day's photographs the spot was dimly marked, as if veiled by fog or by particles too small to be represented separately; but on the second day the region was brilliantly white. The date of the event corresponded with the end of the southern winter of Mars, or with the middle of our February; the event itself was a snow-storm.

The fibrous plants of the island and their capabilities will furnish an important department of the exhibition to be held in Jamaica in January, 1891. Among the native plants of this class are those of the aloe, banana, pineapple, plantain, and nettle families. The managers particularly desire to have a full showing of machines for extracting fibers; and liberal prizes have been offered for the best, provided that no less than three manufacturers compete. Small and inexpensive machines are preferred.

Two theories in regard to the treatment of milk have been tested at the Agricultural Experiment Station, at Cornell University, and both proved mistaken. The way generally practiced for getting the most cream from milk is to set the milk in deep cans in ice-water. It has been asserted that the addition of an equal quantity of water, either hot or cold, to fresh milk in deep cans would secure rapid and complete creaming. The experiments show that the proposed treatment is not nearly as effective as the accepted one; moreover, when hot water was added, the milk was sour at the end of twenty-four hours, and in some cases the cream was injured for butter-making. Setting in shallow pans in the air was found to give better results than any other practice, except deep setting in ice-water.

In a paper read at the meeting of the American Association, Prof. J. E. Siebel sought to show that certain fixed relations exist between the quality of a water and the geologic horizon from which it is derived in a given locality, and that by measuring and analyzing supplies of different depths, with proper precautions, considerable information can be obtained. In applying his method to the underground water-supply of Chicago, the author found that at least six waters could be differentiated in that neighborhood, each having a well-defined and pronounced character.

Some new Indiana crustacean fossils, described by Charles E. Newlin, are found about half a mile south of Kokomo, in a single ledge of the water limestone of the lower Helderberg formation. They are footprints, and appear to be new to the paleontology of Indiana.

THE Appomattox formation of the Mississippi embayment described by W J McGee, which Prof. Stafford identifies with his La Grange formation in Tennessee, corresponds with an area extending from the coast along the Rappahannock River west to the Mississippi and north into Tennessee, which is covered with an interstratified sand and clay, susceptible to erosion and much affected by it. It is said that three fourths of the formation have been removed by erosion. The formation overlaps in irregular lines the Tertiary strata of Virginia. White kaolin, or feldspar clay, is often detected in it, and large quantities of white clay of commercial value have been uncovered in the northern part of Mississippi.

THE Redonda phosphate, described by Prof. Hitchcock in the American Geological Society, is found in the volcanic island of Redonda, in the Caribbean Sea—an island with perpendicular walls five hundred feet high, which the visitor must scale with windlass and rope. The phosphates are found, nearly forty per cent pure, nearly devoid of lime, under a vast quantity of guano. They are not crystalline or fossiliferous, and occur in sheets between the layers of lava, or in pockets. The existence of this valuable substance at such a place has never been satisfactorily accounted for.

ACCORDING to a paper by Prof. S. Coulter, Indiana, which is the fifth lumber-producing State in the Union, has one hundred and six species of trees, belonging to twenty-four orders. The most uniformly distributed tree is the sugar maple, which is found in every county. The author thought that geological formations had comparatively little effect in the distribution of forest trees in the limited area of the State, but that the chief influence came from the elevation of certain general sections and of particular localities, the courses of the streams, and the location of swamps. The forest area of the State has been reduced to 2,000,000 acres, about one tenth of the total area.

PROF. H. W. HENSHAW, describing the Indian method of making maple sugar, maintained that the knowledge of the sugar and the process were aboriginal, dating from times unknown, and not in any degree derived from the white man. Indians collect the sap in bark vessels, which in some cases hold a hundred gallons. They take advantage of cold April nights to freeze the sap, and in the morning throw out the ice. They evaporate the sap by throwing hot stones into the reservoirs. They make sugar also from the silver maple and box elder, and, in Canada and Manitoba, from the birch tree. The sugar is eaten mixed with corn. Venison and rabbits are boiled in the hot sap during the process of evaporation. Sometimes pure sugar is the only diet of Indians for a month.

MR. M. P. MAYO COLLIER disputes the conclusion accepted by many authors that "flat-foot" is due to a general want of tone in the fibrous structure of the body, and traces it by an elaborate physiological argument to overstrain of the ligaments and overpressure upon the *os calcis*, which may be produced by wearing high heels. For treatment of the malady he recommends good food, fresh air, and as much rest as possible, with a radical change in the construction of the boot. The toe and heel should change places; or a good laced boot should be worn, with the sole an inch thick in front and fining off to a line or two at the heel. By this means the normal inclination of the *os calcis* could be maintained, and the weight of the body properly disposed of.

ACCORDING to Prof. F. V. Colville's summary, in the American Association, of the organization of the Botanical Division of the Department of Agriculture, the work is divided into two chief parts, the economical and the scientific; the latter includes some special investigations on forage plants in the Western arid lands. The authoritative position of the bureau gives it special facilities for making exchanges with other countries. The results of the work are published as bulletins and contributions from the scientific investigation. An immense amount of valuable material is being collected in the herbarium. A resolution was passed by the Association calling the attention of the department officers to the necessity of better protection for the collections against fire.

PROF. JOSEPH MOORE reports that an entire skeleton of *Casteroides ohioensis*, or beaver of the days of the mastodon, has been found in Randolph County, Ind., a few miles east of Winchester. The bones indicated an entire length of the animal of five feet nine inches, and that its gnawing powers were commensurate with its size.

PROF. O. A. DERBY explained to the American Association his method of separation, by means of the *batea*, or Brazilian miner's pan, of rare and heavy accessory elements in rocks. By this means certain minerals, regarded as extremely rare, have been shown to be common and widely spread. By his new method of search he had, on the day of his arrival there, found in rocks of New York State minerals never before found in those rocks in this country.

THE Austrian Minister of Public Instruction reported some time ago that the evil of overpressure in the public schools was real and extended, and that its source was not so much in the course of study as in the method pursued. As remedies, he advised a better division of the holidays, and abolition or reduction of written exercises and of memorizing.